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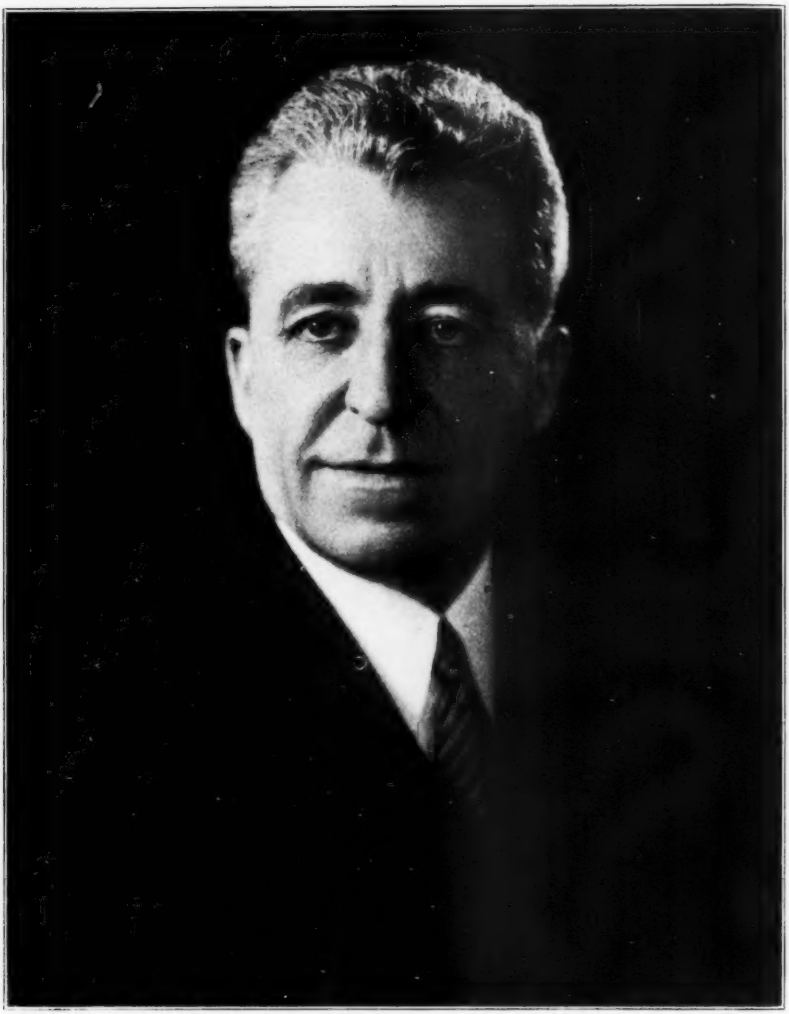

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Original Communications

OPERATIVE DENTISTRY—PAST AND PRESENT*

By RALPH R. BYRNES, D.D.S., F.A.C.D., Atlanta, Ga.

WHILE it is true that operative dentistry, or even dentistry, itself, as a science, did not exist until comparatively recent years, it is a matter of interest, since dentistry is an outgrowth of medical practice, to consider the ancient beginnings of medical practice. It is a matter of common knowledge that even before the establishment of medicine as a profession, ailments of the teeth and other tissues of the oral cavity were treated by various peoples. For the contents of that part of this paper dealing with ancient dentistry and medicine I am indebted to Guerini, for his notable "History of Dentistry."[1]

Sacerdotal medicine was prevalent in antiquity. The earliest medicine was practiced by the priesthood. Apparently, the priests were the first "doctors."

According to Herodotus, the Babylonians were in the habit of carrying their afflicted to the public squares. People passing by who had suffered from similar ailments would pause to give advice based on their own experience. Votive tables also served to develop medicine. These tables, which were hung in the temples, bore descriptions of various maladies and their treatment.

Civilization along the Nile was fairly well advanced in 3892 B. C. Medicine and science have always advanced with civilization. Medical papyri, which throw a light on medical treatment of that day, are to be found in the British, the Berlin and other museums. The most important and the oldest of the Egyptian papyri is the Papyrus of Ebers, in the library of Leipzig University. Prof. George Ebers, distinguished scholar, obtained this papyrus in 1873 from an inhabitant of Luxor, Egypt, and published it in 1875, in Leipzig. While it is impossible to determine the exact date of the writing of this document, it probably was about 1550 B. C. Apparently, it is not an original work of any one person, but is a compilation of earlier medical writings.

*Read at the Seventy-Fifth Annual Session of the American Dental Association in conjunction with the Chicago Centennial Dental Congress, Aug. 10, 1933.

1. Guerini, Vincenzo: History of Dentistry, Philadelphia: Lea & Febiger, 1909.

A passage from Herodotus shows that specialization is no new thing. He says:

> The exercise of medicine is regulated and divided amongst the Egyptians in such a manner that special doctors are deputed to the curing of every kind of infirmity; and no doctor would ever lend himself to the treatment of different maladies. Thus, Egypt is quite full of doctors; those for the eyes, those for the head; some for the teeth; others for the belly, or for occult maladies.

According to George H. Perine, in an article on the history of dentistry, which appeared in 1883 in the *New England Journal of Dentistry:*

> Both filled and artificial teeth have been found in the mouths of mummies, the cavities in the former stopped with gold, and in some cases with gilded wood. Whether those fillings were inserted during life for the purpose of preserving the teeth, or after death for ornamentation, it is, of course, impossible to say.

According to J. G. Marter, a dentist in Rome, "the renowned archeologist Forbes had seen mummies' teeth stopped with gold."

According to Carabellis' "Handbuch der Zahnheilkunde" (1844), many of the peoples of Asia and Oceanica were particularly fond of dyeing the teeth. Before this operation, they often embellished the teeth by filling the interproximal spaces with gold leaf. The practice of dyeing the teeth and filing them to points is followed, even in the present day, by numerous barbaric tribes in various parts of the world. In some localities in Japan, the married women, in order to distinguish themselves from their less fortunate, unmarried sisters, have followed the practice of dyeing the teeth black.

Another common practice of antiquity was that of grinding down the teeth. This usually involved removal of the enamel. Some tribes, such as the natives of eastern India, plane their teeth to a level, accomplishing this by chewing a mixture of areca nuts and chalk.

Knocking out the teeth was also a common practice. This, as well as the practice of filing the teeth to a point, was, no doubt, inspired by a desire to achieve a warlike appearance. In New South Wales, it is customary to knock out the front teeth of boys reaching maturity. This is done with a stone. (Some cumbrous stones still used by some dentists are almost capable of this.) Contrary to the modern esthetics of crown and bridge work, many primitive tribes of the past have regarded missing teeth as an ornamentation.

DENTAL PRACTICES AMONG THE ANCIENT GREEKS

Probably the earliest mention of dental instruments in Greek history concerns a lead instrument for extracting teeth. This was exhibited at the Temple of Apollo at Delphi.

Perhaps the greatest source of our knowledge of early medical and dental methods is Hippocrates. He gathered his information from the sacerdotal and the philosophical schools of medicine and the gymnasiums. He was born about 460 B.C. While Hippocrates devoted no single chapter to the specific discussion of dental ailments, many references to dentistry are found in his works, and some of them cast an illuminating glow over the hazy beginnings of the dental art. Hippocrates gives in some detail a method for reducing fractures of the jaws which sounds very modern.

Aristotle gave some thought to the extraction of teeth in his "Mechanics." He says:

> Why do doctors extract teeth more easily by adding the weight of the ondontagra (dental forceps) than by using the hand only? Can it be said that this occurs because the tooth escapes from the hand more easily than from the forceps? Ought not the irons to slip off the tooth more easily than the fingers, whose tips, being soft, can be applied about the teeth much better? The dental forceps are formed by two levers acting in contrary sense and

having a single fulcrum represented by the commissure of the instrument. By means of this double lever, it is much easier to move the tooth, but having moved it, it is easier to extract it with the hand than with the instrument.

In Aristotle's time and before his time, it was common practice for the person extracting teeth to loosen the tooth with the forceps, after which removal was accomplished with the fingers.

DENTAL ART AMONG THE ETRUSCANS

The Etruscans, whose civilization flowered in middle Italy before the foundation of Rome, have handed down to us some interesting relics of the dental art. In all probability, the Etruscans owed much of their dental art to the earlier civilizations of Egypt and Phoenicia, but there can be no doubt that they carried its development to a much higher plane.

THE ROMANS

According to Guerini, it appears that dentistry was practiced in Rome before medicine was recognized as an organized profession. One of the earliest references to the filling of teeth is that made by the Roman Celsus, who recommends, before the extraction of a carious tooth, filling the cavity with lead or lint in order to prevent fracture.

Celsus also makes an early reference to a primitive form of prophylaxis. He recommends that stains on the teeth be removed by scraping, although no reference is made to the instrument with which this is to be done. He suggests that the mouth be washed with pure wine after this. This procedure would seem surprisingly akin to antisepsis.

Also, he indicates that a modified form of root forceps was used in his time, as evidenced by his words: "Now and again it happens that when a tooth is pulled out, its root remains in the socket; it is then necessary to extract it at once, with the forceps adapted for the purpose, called by the Greeks 'rizagra.'"

Paul of Aegina, who lived in the seventh century A.D., makes a reference in his writings to a dental file, one of the most primitive of all dental instruments. He says: "If a tooth projects above the level of the others, the protruding part must be removed with the file." He advocates the use of the file also in removing sharp edges of broken teeth as well as in removing deposits of tartar.

THE MIDDLE AGES

The Arabians.—Rhazes, who was born about the middle of the ninth century, advised for the filling of cavities in teeth, "cement," a composition of mastic and alum. The Arabians had an abhorrence of all bloody operations, and advised against the extraction of teeth as long as there was any possibility of keeping them in the jaws.

An interesting statement in connection with the removal of tartar and one which demonstrates the early evolution of prophylactic instruments is found in the writings of Abulcasis. He says:

Sometimes on the surfaces of teeth, both inside and outside, as well as under the gums, are deposited rough scales, of ugly appearance, and black, green or yellow; thus corruption is communicated to the gums, and so the teeth are in the process of time denuded. It is necessary for thee to lay the patient's head upon thy lap and to scrape the teeth and molars, on which are observed either true incrustations or something similar to sand, and this until nothing more remains of such substances. . . . If a first scraping is sufficient, so much the better; if not, thou shalt repeat it on the following day, or even the third or fourth day, until the desired purpose is obtained. Thou must know, however, that the teeth need scrapers of various shapes and figures, on account of the very nature of the operation. In fact, the scalpel with which the teeth must be scraped on the inside is unlike that with which thou shalt scrape the outside; and that with which thou shalt scrape the interstices between the teeth shall likewise

have another shape. Therefore, thou must have all this series of scalpels ready, if so it please God.

THIRTEENTH TO FIFTEENTH CENTURY

In Guy de Chauliac's medical works, we come across this interesting quotation, indicating that some crude form of anesthetic was used in his time:

Some prescribe medicaments which send the patient to sleep, so that the incision may not be felt, such as opium, the juice of the morel, hyoscyanus, mandrake, ivy, hemlock and lettuce. A new sponge is soaked by them in these juices and left to dry in the sun, and when they have need of it they put this sponge into warm water and then hold it under the nostrils of the patient until he goes to sleep. Then they perform the operation.

Evidently, this anesthetic was effective, since he speaks of reviving the patient by holding under the nose another sponge soaked in vinegar.

In speaking of filling teeth, Valescus of Taranta, who was a professor in the University of Montpelier at the beginning of the fifteenth century, in his treatise on medicine and surgery, advises filling cavities with powdered nigella, pepper, myrrh, salt and theriac, or with pyrethrum, gum ammoniac and opium, pulverized celery seeds or the cast-off skin of serpents boiled in vinegar. He also believed, as did many others of his time, that worms cause caries.

Pietro of Argelata, professor of surgery at Bologna, who died in 1433, advises the widening of cavities in teeth in order to lessen their tendency to hold food débris.

The first reference that I have been able to find dealing with filling teeth with gold occurs in the writings of Giovanni of Arcoli, whose death occurred in 1484. He advises filling the teeth with "gold leaf." It is quite certain that Giovanni was not the originator of the gold filling and that it had been used previous to his time. He mentions it casually in his writings, simply as an observation.

Giovanni of Vigo (1460 to 1520) advises the use of the drill, file and scalpel for removing "the putrified or corroded part of the teeth." He advises filling the cavity with gold leaf.

THE SIXTEENTH CENTURY

Andreas Vesalius (1514-1564) was the first to make reference to the pulp chambers of the teeth. As it is obvious to all that cavity preparation is based largely on a knowledge of the anatomy of the pulp, the discovery of Vesalius is significant.

Ambroise Paré (1517-1592) spent part of his life as a surgeon-barber, and therefore had ample opportunity to practice the dental art of his day. Paré makes an interesting observation on proximal cavities. He speaks of cavity formation as "erosion." When this erosion takes place between two approximating teeth, he advises separating the teeth by filing, with the admonition that more filing should be done toward the affected tooth than toward the unaffected one. He advocates the use of the file also for planing down a tooth that stands higher than the level of the others. Paré also practiced replantation. After extraction, Paré advises pressing the surrounding gum and alveolus of the tooth with both fingers in order to correct the spread of the bone which may have occurred during extraction.

Paré comments on the advisability of using palatal obturators in perforations of the palate. He was very ingenious in devising obturators.

Girolamo Fabrizio (1537-1619) states that to arrest caries, he dropped oil of vitriol or some other caustic into the cavity, after which he cauterized the tooth. After the cauterization, which in his and earlier times was accomplished through the use of a red-hot instrument, he filled the cavity with gold leaf.

THE SEVENTEENTH CENTURY

Kornelis van Soolingen, a Dutch physician living in the seventeenth century, is reputed to be the first to use emory wheels for grinding down teeth.

Pierre Dionis, an anatomist of Paris, France, who died in 1718, gives considerable information regarding operative procedure in his works. According to Guerini, he speaks of dental operations as being of seven kinds:

1. The opening of the dental arches in the case of spasmodic constriction of the jaws. 2. The cleaning of the teeth. 3. Operations for the preservation of the teeth. 4. Stopping of the carious cavity. 5. The use of the file. 6. Extraction. 7. The application of artificial teeth.

With reference to the cleaning of the teeth, the author naively remarks that gold instruments should be used on persons of rank. This remark can better be understood when one considers that Pierre Dionis was doctor to Louis XIV.

In speaking on "Operations for the Preservation of the Teeth," he advocates scraping caries away, when accessible, and using the file on approximal cavities. He says that cavities of the "triturating surfaces" should be cauterized, and advises the application of a drop of oil of vitriol with a small paint brush. He states that a "cauterizing iron" should be used for advanced cavities.

In the days of Dionis, teeth were filled or "stopped" because of a desire to prevent food substances from lodging in the teeth, and not as the result of an effort to to prevent the spread of caries. He believed that filling the cavity would stop the pain and arrest the carious process. He advocated the use of gold or silver leaf for this purpose, the size of the cavity determining the metal used. He stated that many people preferred to use lead, because of its softness. He also mentioned wax as a stopping in use at the time.

In his remarks on the "Use of the File," Dionis apparently recognizes the fact that teeth become extruded when unopposed, and for that reason he advises against the leveling of unopposed teeth with a file.

THE EIGHTEENTH CENTURY

One of the first references to actual operative procedure in the treatment of cavities occurs in the writings of Lorenz Heister (1683-1758), a surgeon of the eighteenth century. He advises the use of the file for the removal of superficial decay, but suggests that deep cavities be cleaned with a tooth pick or similar instrument before filling with white wax or mastic. He says that molar teeth when decayed in the center should be filled with gold or lead leaf. He advises dropping oil of cloves into a cavity painful from the cleaving process. Heister's "positions" at the chair were rather general. He counsels placing the patients on a low seat or on the ground when extracting lower teeth and placing them on a chair or on a bed when removing the upper teeth.

Rene Jacques Croissant de Garengeot (1688-1759) discredits the use of the file, stating that it destroys the enamel. In France, he was believed to have invented the key instrument named for him, but it has now been shown that he perfected the instrument.

PIERRE FAUCHARD

Pierre Fauchard (1690-1761) is recognized as the father of modern dentistry. Before his time, with few exceptions, dentistry was practiced indifferently as a "side line" by physicians and as a trade by barber-surgeons and charlatans. His great work, "Le Chirurgien Dentiste," was published in 1728, later being translated into German. The book consists of 863 pages.

Fauchard made many interesting and accurate observations on diseases to which teeth are subject, but we must confine ourselves to that part of his writings having reference to operative dentistry.

He did not believe that worms cause caries—an opinion generally held before and during his time—and draws a distinction between certain types of caries. He speaks of "soft and putrid caries," "dry caries," "caries complicated by fracture," "superficial caries," "deeper" and "deepest caries," etc. Fauchard listed four methods of curing caries when the process had not reached the "internal cavity" of the tooth. According to Guerini, they are:

1. The use of files and scrapers. 2. Application of lead. 3. The use of oil of cinnamon or oil of cloves. 4. The application of the actual cautery.

He holds up to scorn some of the fallacious earlier practices for "curing" caries. He describes his general method in the following terms:

When a tooth is but slightly decayed, it is sufficient to remove the caries with the instruments of which I will speak hereafter, and to fill the cavity with lead. If, however, the cavity be rather deeper and occasions pain, one should, having scraped it, put a small ball of cotton-wool soaked in oil of cinnamon or of cloves into the hollow of the caries every day. This medication must be continued for a sufficient time, taking care to squeeze in the cotton-wool by degrees, to accustom the sensitive parts to the pressure. Four or five days later, one removes the cotton from the carious cavity. This treatment sometimes prevents a return of the pain; it produces on the osseous fibers of the tooth a slight but sufficient exfoliation and impedes the progress of the caries. If the pain should not cease after continuing this method for a sufficient length of time, one should have recourse to the actual cautery and stop the tooth for a certain time, if the form and situation of the decayed cavity permit it, for one sometimes meets with cavities that are not able to maintain the stopping.

If the caries penetrates as far as the cavity of the tooth, it may give rise to an abscess; and this I have often observed in persons to whom the caries of the incisors or the cuspids occasioned great pain. In such cases, I introduce the extremity of the sound into the cavity of the tooth in order to facilitate the evacuation of matter. As soon as the pus is evacuated, the pain ceases. I then leave these patients in repose for two or three months; after this time I stop the decayed tooth or teeth to avoid their getting worse.

Fauchard's observations regarding trepanning of the teeth are interesting. In interproximal caries in the cuspids and incisors, involving the pulp, he advocates the use of a small file for enlarging the cavity. He then says that the cavity should be scraped and an opening made into the canal with a perforator or small trepan. "In this way the pus and other humors that may have collected in the tooth can easily find their way out, and the pain will cease at once or in a short time."

After describing the method of trepanning, he continues:

After this operation one should let a few weeks pass without doing anything to the affected tooth, and afterwards, in order to impede further decay, one must put a little cotton-wool into it, soaked in oil of cinnamon or of cloves. The tooth must be left in this state for some months, care being taken to renew the cotton-wool. It is necessary to observe that, in the beginning, the cotton-wool should be put in with lightness and without pressing it down much, so that if pus should gather again, it may be able to make its way through the cotton-wool, the principal object of this being to hinder the penetrating of alimentary substances into the tooth, which would be the cause of further decay. If the cotton were pressed into the tooth from the beginning, the pus, not being able to find an exit, would accumulate, and might cause much pain if the nervous parts of the tooth were not yet dried up or destroyed. The same thing might happen after the application of a lead stopping, and one would be obliged to remove it, and let considerable time pass before putting it in again.

This cotton-wool filling may be considered as a precursor of the cement base used today for capping deep and sensitive cavities in order to palliate the condition

and prepare a foundation for the permanent filling.

Fauchard ridiculed the idea that it was dangerous to extract the teeth of pregnant women. Some of our dentists of today are not so modern as he.

Fauchard placed a value on psychology, as witnessed by his injunction that "one should always take the precaution of hiding the instruments from the patient's sight, especially in the case of extracting a tooth, so as not to terrify him."

Fauchard's second volume is devoted altogether to operative and prosthetic methods. For filling teeth, Fauchard used lead, tin and gold. In commenting on these metals, he says: "Fine tin is preferable to lead, for lead turns black much more easily and is much less durable; both are preferable to gold because lighter and adapting themselves better to the unevenness of the carious cavities." This statement indicates that, in his day, little effort was made toward altering cavities aside from simple enlargement. He exposed the dental "racketeers" in his day when he mentioned the fact that dentists frequently took advantage of those who demanded gold filling by using leaf tin or lead colored yellow, making the patients pay for it as gold.

Three kinds of pluggers were used by Fauchard for introducing and compressing the leaf metals into the cavities. He speaks of one of his lead fillings as having lasted forty years. The cavity was scraped and widened before the filling was inserted.

A quotation from Fauchard shows that he was not unmindful of the importance of considering the pulp in cavity preparation. He says:

> If the sensibility of the carious cavity be too great, the lead ought only to be pressed in very lightly at first, then, after one or two days, a little more, this continuing until it is properly compressed and fitted in, always, provided, of course, the pain does not increase. The sensitive parts of the tooth become thus more easily used to the pressure of the lead and the pain in this manner avoided or moderated.

Fauchard also recognized the necessity of stopping a tooth immediately in case of pulp exposure during cavity preparation.

Cauterization of the pulp of the tooth was the precursor of present root-canal methods. Fauchard used the cautery as a last resort in cases of obstinate toothache. After destroying the "nerve" with the hot instrument (no chemical means for killing the pulp were then known), he filled the cavity with cotton-wool soaked in oil of cinnamon, later filling the tooth.

Lecluse was another celebrated dentist of his time. His chief claim to fame is that he invented or rather perfected an elevator which is still known as the "Lecluse" elevator. Lecluse also claimed to cure caries by filling and replantation.

Philip Pfaff, dentist to Frederick the Great, was the first dentist to use plaster models. Pfaff made wax impressions of the jaw, removing the wax in two pieces. The part that wax played in the development of operative dentistry is exceedingly important. The use of wax has removed a great deal of guesswork from dental operations.

Philip Pfaff actually was the first dentist to "cap" an exposed pulp without cauterizing. Fauchard himself had simply carefully inserted fillings on the exposed pulp. Records do not show, or at least I have not been able to ascertain, just what Pfaff's "capping" was.

Thomas Berdmore, an English dentist, in 1768 published an excellent work on dentistry. He recommends testing the ability of a tooth to tolerate gold before applying the gold filling, advising that a temporary filling of cement or some other such substance first be used.

Frederick Hirsch advocates the use of

a cement of turpentine and quicklime for filling cavities.

Benjamin Bell, an English contemporary of the great surgeon Hunter, was opposed to the use of the then popular dental file. He advised filling cavities with mastic, gum lac or wax. He was probably the first to make reference to the shapes of cavities. He advised the use of gold or tin foil when the cavity was wider at the bottom than on the surface. Like others of his time, he was much concerned with the transplantation of teeth.

A significant advance in operative procedure is found in the writings of Heinrich Callisen, published in Copenhagen in 1788. He was convinced that it is harmful to file or scrape a decayed tooth without filling it. He also asserted that the bottom of a cavity should be wider than the top; an opinion that existed until the time of G. V. Black.

AN OUTLINE OF OPERATIVE DENTISTRY IN AMERICA FROM EARLIEST TIMES UP TO THE YEAR 1876

For the information contained in this section, I am indebted to "A History of Dental and Oral Science in America," published by the S. S. White Company, under the auspices of the American Academy of Dental Science, in 1876.

It is not known definitely when teeth were first filled, although we do know that fillings were made during the eighteenth century and perhaps earlier. The dentists of very early times concerned themselves mostly with extractions and general affections of the oral cavity and neglected the operative phase of dentistry. Indeed, only the very best dentists were able to fill teeth effectively with the instruments at their command. America has taken the lead in the evolution of operative dentistry since the time of Fauchard.

Lead Fillings.—Although certain soft substances such as wax and various "cements" were used before lead, we may rightfully consider lead as the earliest known filling material. The lead used was in sheet form, and the manipulation of it was comparatively simple. It was rolled between the fingers and placed in the cavity. In the early days of its use, little, if any, cavity preparation was made to receive it. The best dentists did nothing more than remove as much of the decay from the cavity as they could with their crude instruments, sometimes also enlarging the cavity. The lead was packed down or forced into place by two straight instruments used for the purpose, after which it was polished with a burnisher. It is interesting to note that the French word for filling, "plombage," means lead. Many dentists were eager to secure the sheet lead in which shipments of tea from China were packed. Lead was the forerunner of amalgam, and more closely resembles that filling material from the standpoints of physical appearance and manipulation than any other.

Gold.—According to Chapin A. Harris' "Dictionary of Dental Science," the use of gold as a filling material began in the early part of the eighteenth century, but most investigators date its inception in the latter part of that century. According to Harris, the use of gold as a filling material did not become common until 1800. Robert Woofendale, an English dentist who returned to New York in 1795, has been credited with its introduction in America.

Like lead, gold was first used in leaf form. As it was not manufactured in this form, dentists found it necessary to have a "gold beater" reduce certain gold coins or other soft gold to leaf form. A Brazilian coin known as the "Johannes" was much sought for this purpose, since its high gold content made it soft and capable of being easily beaten into leaf. Leaf

gold was, of course, noncohesive. Therefore, dentists had to rely consciously or unconsciously on certain physical principles for its retention in the cavity. The noncohesive property of this material was responsible, to a great extent, for a mode of "cavity preparation" which was later to become popular, one in which the cavity was given a funnel shape with the base of the cavity covering a larger area than the surface. Rolled gold was later substituted for gold leaf. The first gold-beating business was established in Hartford, Conn., in 1812 by Marcus Bull. Here, in the language of Mr. Charles Abbey, who became the apprentice of Mr. Bull, dentists would "borrow his rolls to roll out their 'old Joes' " (meaning the Johannes coins). In 1835, the house discontinued the manufacture of gold leaf and began making dental foil.

In filling cavities with gold leaf, the same technic was observed as with the lead fillings already mentioned; i.e., the leaf was rolled into "pellets." After placing the pellet in the cavity, the dentist would often make a hole in the pellet with a sharp instrument and insert a cone-shaped roll of gold in the aperture. This would cause a wedging in the gold and bring it into closer contact with the "walls" of the cavity. It was often customary to have a surplus of gold extending beyond the margins of the cavity, the dentist hoping to get additional condensation through the movements of mastication. As the technic became more refined, a thinner gold leaf was manufactured. Some leaves of gold manufactured at a later time contained only 2 grains by weight, although the average weight was from 4 to 6 grains.

With the increasing lightness of the gold leaves, the technic was changed somewhat. The gold was twisted into a "rope," and in this form was wedged into the cavity. These ropes were folded when placed in the cavity. In the smaller cavities, the ropes were often too large, in which case the dentist would coil half or a third of a sheet over a watch spring and use the gold in smaller rope form.

It will be in order here to quote verbatim a paragraph or two from the "History of Dental and Oral Science in America." The compiler says:

> About the time from 1840 to 1845, isolated members of the profession began to coil ribbons of gold upon a winder; thus forming cylinders. These cylinders, however, were still inserted upon the principle of the old-time pellet, being wound so tightly as to be little compressible, and to a size just sufficient to enter the cavity into which they were forced, first by small and then by larger instruments, the coils being of sufficient depth to extend above the margin.

C. T. Jackson, of Boston, Mass., is said to have discovered the manufacturing process for "sponge" gold, and it is recorded that the first filling of that kind was inserted in one of his own teeth. Not until 1853 was any public attention given to sponge gold. This material, heralded as an ideal filling material, did not live up to its claims and gradually lapsed into disuse. The next step in gold manufacture was "crystal" gold, which its manufacturers claimed possessed unusual qualities. It was claimed that water or saliva would not impair its quality of cohesion. Operators who had been inspired to enthusiasm for this "ideal" gold filling soon found the claims to be exaggerated.

Let us turn back some of the pages of the past and see how gold work was done prior to the discovery of gold foil. I shall quote from the Proceedings of the American Dental Convention, held at Niagara Falls, Aug. 2, 1859, as contained in the *Dental Cosmos* for September of that year. Incidentally, this will throw a revealing light on the manner in which dental association meetings were conducted in those days and will

give us an idea of the characters of papers presented. The reporter of that meeting said:

> The President announced the next subject for debate to be "Filling Teeth." Dr. J. G. Ambler, of New York, stated his practice in filling fangs where cheapness is required. He places a pellet of gold at the apex of the fang, then fills with gutta percha and caps with gold; only uses this where patients are unable to pay.
>
> Dr. Forbes said that in America the servant girl would have as good work in her mouth as her mistress. He thought to study how to do cheap work had a tendency to introduce bad work. The work of filling he would consider under five divisions: first, the preparation of the cavity; second, the preparation of the gold; third, preparing the mouth; fourth, filling the tooth; fifth, finishing.
>
> 1. He would take an instrument so large that it would not enter the cavity, and remove all superficial discoloration. He would break down the borders until the walls of the cavity were perpendicular. He would cut down to the bottom with his favorite gouge instruments Then he would bevel, or counter-sink, the mouth of the cavity as for a screw-head.
>
> 2. Cut a book of No. 4 foil, book and all, fold into strips of eight thicknesses; make cylinders of these strips, by laying each strip on a cushion and rolling it on a broach.
>
> 3. The only difficulty in preparing the mouth is with the under teeth. He would surround the tooth with a piece of muslin, or a napkin, and support it with his fingers.
>
> 4. Suppose the cavity to be three lines in diameter and the same in depth. He would take a cylinder having the same diameter but long enough to project a line out of the cavity when standing on its bottom. With a flat instrument he would press this cylinder firmly to one side. The cavity would thus be about half filled. The remaining half he would fill part way up, as it would be difficult to get a slim cylinder to go entirely to the bottom. With short cylinders he would fill the remainder of the cavity. With a pointed instrument he would pierce the surface of the plug, where practicable, and fill in with adhesive gold.
>
> 5. He would finish in the usual way.
>
> Dr. Frank Fuller of Portsmouth does not leave a shoulder to his cavities, but cuts out the fissures in the molars with the instruments of Dr. Forbes, shapes his cavity in molars larger at the top, making it cone-shaped; inserts his gold so that it will act as a wedge, and can then make an exceedingly dense filling.
>
> Dr. William H. Atkinson has been requested to give his views on the use of the mallet in filling teeth. The mallet, he said, was a powerful condensing instrument. He had used it in the earliest years of his practice, but abandoned it out of respect for authority. He had taken it up out of respect for his own judgment and conscience. He had successfully filled front teeth by using it; that he could not so regulate the force as to fill without it.
>
> In preparing cavities when the enamel is undercut, or not strong, it was important to bevel or countersink the margins. And in filling with cylinders, he said, adhesive foil should not be used, as it would choke the cavity.

In 1855, we were ushered into the "gold foil" era, a Dr. Arthur, of Baltimore, Md., having advocated its use in that year. His so-called "new method" consisted of annealing the gold over a spirit lamp. As is well known, such a procedure developed the cohesive property of the gold. The use of gold foil has been largely responsible for the advancement of correct cavity preparation.

This type of gold became very popular, but with its use a problem arose. Dentists found that cohesive gold could not be used very well for beginning a filling in the base of the cavity. It did not stick well to the floor of the cavity and had a tendency to ball up. This fact led to the use of retention pits in the angles of the cavities, then called "retaining pits." This principle survives to this day. Coincidently with the adoption of gold foil, serrated gold plugger points were put on the market. Gold foil fillings then became exceedingly popular. In their enthusiasm, numerous dentists attempted to restore whole tooth crowns with gold foil, such restorations becoming known as "contour fillings." The development of gold foil marked a tremendous stride in operative dentistry. Since the intro-

duction of this material, there has been less change in the preparation of cavities for gold foil than for any other type of filling material. The principles which held in 1876 hold in a measure today. Gold foil, where indicated, remains an ideal filling. Owing to the comparative difficulty of manipulation and the time consumed in its use, its employment has been gradually restricted throughout the years. There is little gold foil work being done in America today.

Tin.—Tin at one time was very popular as a filling material. It came into general use about 1830. It required approximately the same type of cavity preparation as gold foil, and its cheapness and ease of manipulation enhanced its popularity. The extensive use of gold and the introduction of plastic fillings were chiefly responsible for its growing disuse.

Terrometallic Cement.—Among the early forms of plastic fillings terrometallic cement may be mentioned. The composition of this substance was sulphate of lime and oxide of iron. This cement, fortified with morphine, constituted the famous "anodyne cement" of past years. This cement was of little permanent value, as it had a tendency to become brittle and fall out.

"Fusible Metal."—Not until this material came into use did the dentists of America have a plastic filling possessing any degree of permanence. This "fusible metal" included a variety of cements. One of the most important was D'Arcet's "mineral cement," consisting of eight parts bismuth, five parts lead and three parts tin, with an addition sometimes of one-tenth part of mercury, which was added to accelerate the fusing. This material was introduced in America in 1820, and came into general use.

In 1860, D'Arcet's cement lapsed into disuse and was supplanted by "Wood's metal," which suffered the same fate as its predecessor and was consigned to limbo. D'Arcet's cement became plastic at 212 F., Wood's cement reaching that condition at 140 F. Wood's cement was placed in the cavity in a cold state, in pieces. A hot instrument was then applied to it to make it plastic. D'Arcet's cement was melted and poured into the cavity after the cavity had been cleaned and dried.

Asbestos.—"Believe it or not," asbestos was used about 1840 to line sensitive cavities and to act as a base under metallic fillings. It was employed because of its nonconductivity. Its use was short-lived.

Amalgam.—About 1826, M. Taveau, of Paris, France, recommended to the dental profession his "silver paste" as a permanent filling material. This substance with the poetic title was later to become known as "amalgam." M. Taveau's silver paste was simply an alloy of silver and mercury. About this time, it was the custom for dentists to file down a silver coin to obtain the silver filings. These were mixed with mercury much in the same manner that the alloy is incorporated today; i.e., the excess mercury was extracted by pressure with pliers. Apparently, no attempt was made to arrive at the exact proportions of mercury and silver. The excess mercury was simply expressed.

Another modification of amalgam was proposed by Elisha Townsend in 1855, his formula consisting of silver, four parts, and tin, five parts. These metals were melted together, filed and mixed with mercury, after which the material was washed with absolute alcohol. After the mercury was expressed from this mass, a brittle substance remained which, to use the words of its originator, "can be broken into pieces and be made to adhere to each other so as to form a uniform solid mass." According to an ar-

ticle appearing in the *Dental Cosmos,* this amalgam was the kind most generally employed by dentists in 1863.

From Harris' Dental Dictionary, we learn that, in the early days of amalgam use, certain nonmetallic substances, such as powdered glass, were often incorporated, the idea being that the addition of such material would increase the property of the metal to resist the forces of abrasion. Such materials were later found to lessen the homogeneity of the compound, and were later discarded. Among other metals which have been used in amalgams may be mentioned palladium and platinum.

From a historical standpoint, one of the most interesting chapters in American dentistry is that which concerns the so-called "amalgam war." The manner of the introduction of amalgam into this country was not a happy one, and a great prejudice against it was engendered because of the characters of the individuals who introduced it. In the "History of Dental and Oral Science in America," they were referred to simply as "the Crawcours." (I have not been able to determine just how many of "the Crawcours" there were, although I am inclined to believe there were two of them, since they also were referred to as the "Crawcour brothers," and we usually think of brothers in pairs.) It appears that these foreign gentlemen suddenly appeared on the scene in New York and catapulted themselves at once into the minds of the citizenry with the aid of a tremendous amount of that precious quality which today we would call "ballyhoo." The high-powered advertising methods of these adventurers and their florid claims for this new material shocked the more conservative members of the profession as nothing had done before.

The poor technic these men employed was another reason for the hostile reception given to them and to amalgam in this country. It is reported that their manipulation of the material was so slovenly that often patients left their offices with mercury exuding from between the teeth. Also, it is recorded that they inserted amalgam in the interproximal spaces of teeth where no cavities existed. So violent was the antipathy for the new material that certain dental societies even went so far as to expel their members found guilty of using it. Nevertheless, amalgam began gradually to supplant gold foil in practice and demand, and this added more fuel to the hatred of its opponents. It was, indeed, an "amalgam war."

In the "amalgam war," if victory was denied its adversaries on the general front, it was at least won in that sector where the Crawcours were entrenched with their mortars. They were forced to flee the country. It appears that, in the days of the "amalgam war," as well as in the present time, an amalgam filling is no better or worse than the integrity, character and skill of the operator inserting it and preparing cavities to receive it. We know now that amalgam has its limitations just as all other filling materials have theirs, but that it is a good filling material where indicated. Also, we know that the comparative ease with which the material can be manipulated operates both for and against it. In preparing cavities for amalgam, the older dentists simply hollowed out a hole in the tooth to receive it, a hole with its base larger than its opening. Even today, dentists are more careless in the preparation of amalgam cavities than they are in their preparation for almost any other type of filling material.

The Inlay.—According to J. A. Taylor's "History of Dentistry," J. L. Murphy, in a book published in 1837, was the first to describe the inlay. Taylor also

states that attention has been given to inlays in dental journals since 1858. Inlays have been made from artificial teeth, this being accomplished by grinding the tooth to fit the cavity. The pieces thus prepared were held in place by various kinds of cement. "Glass" inlays also have been made in the past. These glass inlays were baked in platinum matrices and cemented in the cavity. Porcelain inlays then came into use, and, later, gold inlays. Apparently, the desire of the profession for inlays was actuated by a dissatisfaction with the efficacy of plastic fillings and a yearning for a filling material having more desirable qualities. Also, it is obvious that dentists have realized that plastic fillings are not satisfactory in extensive restorations and that the extreme care and time required for the insertion of gold foil in such complex restorations make its use inadvisable for economic reasons. The inlay was the logical outcome.

I shall not attempt to consider in this paper the familiar events in the development of the gold inlay except to mention that to Dr. Taggart goes the credit for having perfected and popularized the inlay technic involving the now commonly known process of obtaining the wax pattern, investing and casting. With the exception of gold foil, no other filling material has been so responsible for the employment of scientific cavity preparation. The inlay has nearly revolutionized operative dentistry.

In closing a paper on the development of operative dentistry, it is fitting that tribute be paid to the man who has done more than any other to put operative dentistry on a scientific basis, Greene Vardiman Black. Black's great work is monumental, so far as dentistry is concerned. His system of cavity preparation, and, specifically, his principle of "extension for prevention" have placed operative dentistry in the class of a scientific procedure. His work is great because it goes beyond common expediency. It is based upon the broadest principles. Although modifications will be made from time to time, it will stand as a classic example of precision and genius in dentistry. Improvements will be made in cavity preparation as time goes on, since no achievement is ultimate, but the principles of Black will remain steadfast. The modern "slice" preparation for inlays is an outstanding example of a development of recent years, and there will, no doubt, be many others, but Black's work will continue to exist as the foundation upon which modifications will be made.

Also, in closing, I should like to hazard a guess as to the next great development in operative dentistry. It will be a plastic filling material, an impermeable substance that satisfies all the requirements of an inlay, which corrects certain weaknesses of the inlay, and which can be inserted with less time and effort. "History repeats itself," and dentistry will turn again to the plastics.

VINCENT'S INFECTION OF THE MOUTH: CLINICAL INCIDENTS IN ITS DIAGNOSIS AND TREATMENT*

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THE diagnosis of acute Vincent's infection of the mouth is a comparatively simple matter for those acquainted with its stereotyped description in the numerous writings on the subject, but it is quite evident, both from questions asked during lectures and clinics and from the apparent frequency with which cases of the infection pass through the hands of the general practitioner, incompletely treated and at times even unrecognized, that the dental profession has much to learn regarding the diagnosis and treatment of this condition, especially in stages other than the acute. It is the aim of this paper to discuss various clinical observations pertaining to diagnosis and treatment that have not been sufficiently stressed, if described at all, in dental literature.

CLINICAL DIAGNOSIS

Vincent's infection is described generally as a rapidly destructive disease in the wake of which the teeth remain more or less divested of paradontium. In the last few years, attention has been called to its appearance in another form, designated as "atypical," which presents gingival hypertrophy instead of destruction. This occurs sufficiently often to make the term "atypical" inadequate and to justify a classification[1] of the infection into two main types: the destructive and the hypertrophic.

In the destructive type, the outstanding clinical symptoms are ulceration and sloughing of the marginal gingivae, especially interproximally (Fig. 1). The necrotic layer, yellowish white or grayish white, may be easily wiped off its highly inflamed base. The lesion thus exposed is extremely painful and bleeds freely on the slightest provocation. The inflammation may be quite superficial macroscopically, so that only a red line of demarcation is evident. More often the entire gingiva may appear bright or bluish red, or there may be only linear areas of such discoloration extending vertically across the alveolar gingiva toward the areolar fold of the cheek, as shown in Figure 4, between the lower left lateral incisor and the cuspid. The ulceration may occur on the mucous membrane of any other part of the mouth and throat in the form of yellowish, or grayish, white patches with well-defined inflammatory margins. The fetid breath, almost always evident, is distinctly characteristic and easily recognizable. These symptoms usually come on suddenly and are often accompanied by a metallic taste, increased salivation and swelling of the submaxillary lymphatic glands, also malaise, rise

*Read at the Seventy-Fifth Annual Session of the American Dental Association in conjunction with the Chicago Centennial Dental Congress, Aug. 10, 1933.

1. Hirschfeld, Isador: Toothbrush Contraindicated in Acute Hypertrophic Gingivitis, D. Items Int., 54:651-652 (Sept.) 1932.

in temperature and mental depression.

In the hypertrophic type of Vincent's infection, the subjective and objective symptoms are the same as in the destructive, but, as the term implies, there is a marked acute gingival hypertrophy, with or without macroscopically evident necrosis. (Usually, even if a necrotic border is evident, there is little loss of gum tissue as an aftermath.) In some cases, the papillae alone become hypertrophied; while, in others, the entire gingiva swells (Fig. 2), covering a considerable portion of the crowns of the teeth, a condition existing that is not unlike the hypertrophy in acute lymphatic leukemia. Such cases appear quite often, and the condition needs to be differentiated from other types of gingival hypertrophy. It must also be pointed out that an acute Vincent's infection may be superimposed on a chronic hypertrophic gingivitis. A further enlargement of the tissue then ensues. In such an instance, after the acute symptoms have disappeared, it is advisable to reduce or eliminate the preexisting hypertrophy as a preventive measure against an acute reinfection, to which it is predisposed.

Fig. 1.—Acute destructive Vincent's infection. When the necrotic interproximal papillae, especially in the lower jaw, were wiped away, the gingivae had a punched out appearance. Beyond the serpiginous, gray necrotic line, the gum is highly inflamed. There is marked hemorrhage, especially on the left side. Blood may be seen oozing from between the lower left lateral incisor and the cuspid.

Fig. 2.—Acute hypertrophic Vincent's infection. In contrast to the destruction seen in Figure 1, there is hypertrophy of the entire gingiva, which was tender and bled easily. A thin gray necrotic line may be seen along the margin of the upper gingivae. (The other white markings are merely high lights produced in making the photograph.) The hypertrophy was of recent onset and disappeared with the other symptoms in response to the anti-Vincent's treatment.

DIFFERENTIAL DIAGNOSIS

Cases of Vincent's infection in which only a few of the typical symptoms are present may be easily mistaken for other pathologic conditions that have similar characteristics. A clinical differential diagnosis is of vital importance, especially since it has been shown[2] that the bacterial findings, either positive or negative, are not an absolute guide, and are therefore unreliable in diagnosing this infection, owing to the fact that the Vincent organisms are frequently found in great quantities in mouths showing no clinical symptoms of the disease.

Among the lesions most likely to be diagnosed as destructive Vincent's infec-

2. Hirschfeld, Isador: Vincent's Infection of the Mouth, New York M. J. & Rec., 118: 150-154 (Aug. 1) 1923.

tion, or vice versa, are: (1) pyorrhea alveolaris (suppurative periodontoclasia); (2) aphthous stomatitis; (3) lesions produced by mechanical trauma; (4) chemical burns; (5) lesions produced by ingestion of drugs; (6) tuberculosis; (7) syphilis; (8) pemphigus; (9) diphtheritic sore throat; (10) herpetic lesions, and (11) agranulocytic angina.

The following must also be differentiated from hypertrophic Vincent's infection: (1) proliferative gingivitis of pregnancy; (2) mouth breathing and other types of chronic hypertrophic gingivitis; (3) mercurial stomatitis; (4) scurvy; and (5) acute leukemia.

Fig. 3.—Recurrent subacute Vincent's infection, showing bright red edematous points of papillae on either side of upper right cuspid, which bled freely when touched. The edematous appearance of the papillae between all the lower anterior teeth is evident. Also the zigzag outline of the gingiva.

The differential diagnosis of all of these has been published elsewhere.[3] It is important to call especial attention to one of these, agranulocytic angina, a serious condition due to a blood disease, which, in recent years, has shown an increased incidence. It may resemble acute Vincent's infection very closely both in sudden onset and the presence of necrotic lesions in the mouth and throat, and its early detection is urgent. Brought to the attention of the medical profession only about ten years ago with reports of a few cases, this disease, with its extremely high mortality rate, has aroused widespread interest as to its etiology and treatment. Within the last three or four years, an increasingly large number of cases have been reported. When fatal, it usually runs a rapid course, but the incidence of recovery seems notably on the increase, especially when it is recognized and treated early. Therefore, whenever a case of necrotic gingivitis, or stomatitis, diagnosed as acute Vincent's infection, does not respond to routine treatment with the characteristic rapidity within twenty-four hours, it is advisable that the operator consider the possibility of agranulocytic angina and forthwith suggest a blood count. The characteristic blood picture shows a marked reduction in leukocytes and an almost complete absence, or an extremely low percentage, of granulocytes. The outstanding clinical symptoms are ulceration of the mucous membranes, most frequently in the mouth and pharynx, fever, more or less prostration and, occasionally, jaundice. The great majority of cases occur in women past middle life, but it is seen in both sexes and is not limited to any age. While the Vincent organisms are sometimes found in the necrotic lesions, which they help to aggravate, they are not considered to be the cause of these ulcerations. Evidently, the etiologic factor of this disease has not, as yet, been established, but the underlying pathologic lesion is in the bone marrow. (In a report by Madison and Squier entitled "The Etiology of Primary Granulocytopenia [Agranulocytic Angina]," and published in the *Journal of American Medical Association*, March 10, 1934, evidence is pre-

3. Hirschfeld, Isador: Toothbrush Contraindicated in Acute Hypertrophic Gingivitis, D. Items Int., 54:811-814 (Nov.) 1932.

sented which suggests very strongly that "amidopyrine alone or in combination with a barbiturate, is capable of producing primary granulocytopenia in certain individuals who have developed sensitivity to the drug." They also recall that such etiologic relationship has already been demonstrated for arsphenamine.)

SUBACUTE AND CHRONIC VINCENT'S INFECTION

The large majority of Vincent's infections today are evidently not acute, particularly if we take into account the many persons who harbor the infection in a mild form and therefore do not seek consultation. Apparently, the infection has taken on milder forms in which the symptoms are modified in many respects and vary greatly from the well-defined acute symptoms, aside from the cardinal ones: easily produced hemorrhage and the essentially interproximal localization of the disease. (Tenderness may in some instances be temporarily absent.)

These modifications toward a subacute or chronic character of the symptoms are probably accounted for by such conditions as the acquisition of a somewhat raised immunity, a decrease in the virulency of the organisms or a partial control of the infection through the general use of the numerous mouthwashes and dentifrices widely advertised for the cure, elimination or prevention of "halitosis and bleeding, tenderness and swelling, of the gums." Whatever the cause, the infection as it is seen today presents clinical pictures in which a great diversity in the degree of development of the symptoms is found. The dentist is thus apt to be more baffled as to the diagnosis of Vincent's infection in its milder forms than as to that of any other type

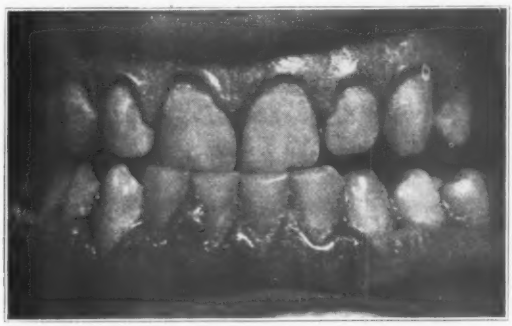

Fig. 4.—Vincent's infection showing an unusual variety of gingival symptoms in one mouth, ranging from those of destructive to those of hypertrophic type. Any one of these suggests the probability, or at least the possibility, of a Vincent's infection and should prompt a detailed examination. The elongated labial flap of the papilla between the upper right central and lateral incisors; the hypertrophied, edematous papilla between the lower right central and lateral incisors; the short, but broad, edematous papilla, which became shorter but broader, between the lower left lateral incisor and cuspid, and the bright red vertical, linear area extending down to the areolar mucosa and indicating inflammatory reaction to the acute infection in the papillae; the truncated cone-shaped papilla between the lower left cuspid and first bicuspid; the partly punched out papilla with an interproximal pocket between the labial and gingival flaps of tissue; an edematous papilla neither elongated nor shortened between two lower central incisors, etc., may be noted. With successfully directed anti-Vincent treatment, a normal condition throughout was restored.

of periodontal disease. The diagnosis becomes still more difficult when the clinical picture is further modified or complicated by other diseases of local or systemic character.

A tabulation, therefore, of the subjective symptoms as well as of morphologic and color variations in the periodontium that individually or in combination indicate, or at least are highly suggestive of, a Vincent's infection in its more subtle manifestations should prove helpful in its detection and diagnosis. In ascribing these symptoms to Vincent's infection, I am influenced essentially by two clinical observations: their frequent association with the acute or subacute conditions and their tendency to react rapidly to routine anti-Vincent's infection treatment. They include the following:

1. A bright red edematous appearance of the points of the papillae, associated with tenderness to the probe and easily provoked hemorrhage (Figs. 3, 10 and 14). Such a condition might continue for a long period without the patient's knowledge, if a brush is not used or if the brushing technic employed precludes the contact of the bristle ends with the involved area, but may be discovered by the dentist during the course of a general examination. On the other hand, these symptoms may be sufficiently marked to induce the patient to seek consultation.

2. A bright or deep red, edematous hypertrophied papilla that extends a considerable distance toward the incisal edge, as shown in Figure 4, between the lower right central and lateral incisors.

3. Edematous papillae that have become shorter in about the ratio that they grew heavier (Figs. 5 and 8).

4. Edematous papillae with a flat, instead of a rounded, end; thereby having become truncated-cone shaped (Fig. 7). This I consider a pathognomonic symp-

Fig. 5.—Subacute Vincent's infection symptoms perceptible only on closest examination. The patient was photographed for the purpose of recording the gingival toothbrush trauma recession. It was not until hemorrhage was produced by the light mopping of the gums to prevent highlights at the time of photography that bleeding of the slightly shortened and thickened edematous papillae on the slightest provocation was observed. The tissue was not tender. Such mild symptoms of Vincent's infection frequently pass unnoticed by the practitioner. It is interesting to observe that although the patient brushed the gums sufficiently hard to cause recession of the labial gingivae, the method of brushing (brisk, circular strokes) was not effective in the interdental embrasures, where the resultant unhygienic condition predisposed the tissue to Vincent's infection.

Fig. 6.—Case shown in Figure 5, after successful treatment of the Vincent's infection, and the subsequent improved toothbrush technic. The pointed, thin stippled interproximal gingivae are now restored to normal length.

tom of the subacute infection, since it is rarely, if ever, seen associated with any other condition.

5. A division of the apex of the papilla into a labial and a lingual semi-edematous segment, one or both being unduly lengthened, so that they partly cover the

Fig. 7.—Subacute Vincent's infection showing truncated cone-shaped papillae in lower jaw, also shortened labial segments of papillae between upper left incisors and cuspid, which, even in photograph, suggest presence of interproximal pockets underneath them.

Fig. 8.—Subacute Vincent's infection. The upper jaw shows a stub-shaped papilla between the central and lateral incisors; the lower, a spiral outline of the gingival margin from the right central incisor to the first bicuspid.

interdental embrasure in apron-like fashion as they approach the incisal plane, as shown in Figure 4, between the upper right central and lateral incisors.

6. A labial flap of a slightly edematous papilla with the point cut off squarely, resembling a stub-shaped pen point, as shown in Figure 8, between the upper right central and lateral incisors, also a pathognomonic sign.

7. The division of a mildly edematous

Fig. 9.—Case shown in Figure 8; after treatment. The papillae and the gingival margins are again of normal contour.

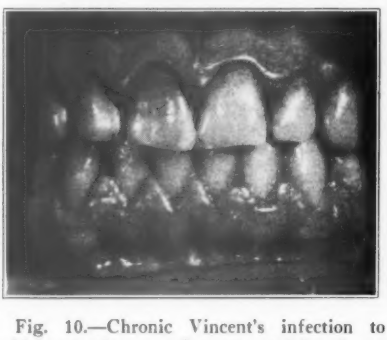

Fig. 10.—Chronic Vincent's infection to which attention was first attracted by zigzag outline of gingival margin of lower anterior teeth.

papilla of normal, or shorter length, into a labial and a lingual segment by a more or less deep cleft running mesiodistally between them, so that the cervical part of the approximal surfaces of the adjoining teeth is exposed to the probe, as shown

in Figure 7, between the upper left incisors and the cuspid, and in Figure 3, between the lower anterior teeth.

8. A deep interproximal pocket (in which food impaction as the causative factor has been ruled out) with or without pus formation. This is to be differentiated from approximal pyorrheal pockets which may be formed on either or both sides of the septum. In the latter type, a partition of gingival tissue usually remains between the adjoining teeth. In other words, in the pyorrheal pockets, uncomplicated by the necrotizing influence of Vincent's infection, there is a tendency for the soft septal tissue to be retained in its position regardless of the depth of the pericemental detachment on either the mesial or distal or both sides. A superimposed Vincent's infection usually tends to destroy this partition, thus producing a single interproximal pocket bounded mesiodistally by the denuded approximal root surfaces on either side, and buccolingually by the labial and lingual flaps of gingiva that remained unaffected by the bacterial destructive process. Usually, the floor of such a pocket is extremely tender when touched by the probe and considerable hemorrhage is produced.

9. A punched-out appearance of the septal gingivae, producing a concave instead of a convex margin, such as is commonly seen in the acute destructive infection; with or without evident necrotic tissue. Such a condition without necrotic tissue may in some instances be caused by food impaction, from which it must be differentiated.

10. The appearance of the gingival margin as a zigzag line over a group of anterior teeth, because their individual normal parabolic curves become sharp angles through the edematous reaction of the septal tissue to the infection (Figs. 3 and 10, lower jaw).

11. A spiral-shaped appearance of the gingival margin over a group of teeth (Fig. 8, lower right), caused by the

Fig. 11.—Chemical burn by escharotic, in mild proliferative gingivitis of pregnancy improperly diagnosed and treated as Vincent's infection. The condition became painful only after the marginal gingivae were burned, as indicated by the white discoloration in the lower jaw.

Fig. 12.—Chemical burn caused by use of potassium dichromate topically in treatment of Vincent's infection. A hard raised mass of brightly discolored gingival tissue partly overlaps the areolar mucosa. The upper part was canary yellow while the lower was green and mosslike. The discoloration was probably due to the action on the necrotic tissue by both the potassium dichromate and the acriviolet which was applied later. The escharotic drug was discontinued and a bland antiseptic wash prescribed. Within a few days, the entire pad of dead tissue sloughed off, leaving the underlying roots exposed. (Compare Fig. 13.)

papillae becoming shorter and more nearly round, while the labial marginal gingivae retain their normal arc.

12. The outline of the gingival margin as a more or less straight line, over a group of teeth, the result of the destruction of the septal gingivae down to their bases, or the swelling of the labial gingivae up to the level of the apices of the papillae (seen only occasionally).

13. A generalized subacute gingival hypertrophy of recent onset. This must be differentiated from more or less serious conditions of systemic origin.

14. A history of repeated recurrence of gingival tenderness and hemorrhage.

Fig. 13.—Case shown in Figure 12; three weeks later. There is exposure of the roots as well as of the crest of alveolar process (between the cuspid and first bicuspid), as a result of the sloughing away of the necrotic gingival tissue. In due time, this exposed bone, also affected by the chemicals, formed a sequestrum, which was later removed.

This may be a characteristic indication of subacute or chronic Vincent's infection, but in women it must be differentiated from a possible menstrual gingivitis, in which these symptoms usually become manifest several days before the period.

15. A metallic taste of recent onset even when unaccompanied by the acute symptoms.

16. Marked halitosis, even when associated with only mild symptoms of Vincent's infection.

17. In addition to the foregoing, the roentgenogram sometimes suggests the presence of Vincent's infection in the first and second molar region, when the pathologic interproximal septal radiolucency extends beyond the level of the normal alveolar process in the bifurcation, this indicating that the destruction tends to be limited to the interproximal tissue—a characteristic of this infection; similarly, in the anterior part of the mouth, when the teeth remain quite firm in spite of marked interproximal radiolucency.

Fig. 14.—Subacute Vincent's infection showing inflamed hypertrophied papillae. The dentist in charge of the case, unaware of the presence of the Vincent's infection, because the papillae were neither necrotic nor "punched out," had attempted to treat the gingival pain and hemorrhage with astringent washes and vigorous brushing (both of which are contraindicated in Vincent's infection). The brushing traumatized the buccal gingiva of the upper jaw, causing abrasions of the mucous membrane, with the resultant necrotic lesion seen in the upper cuspid and bicuspid areas. The condition responded readily to routine anti-Vincent's treatment.

OCCASIONAL BYPRODUCTS OF ANTI-VINCENT'S TREATMENT

As a result of the marked increase in the number of cases of the infection treated by inexperienced practitioners,

medical or dental, and in the number of individuals who use the various advertised mouthwashes indiscriminately, additional factors have arisen that must be reckoned with by the periodontist in a consideration of the diagnosis of Vincent's infection; namely, the undesirable byproducts of anti-Vincent's treatment, chemical burns and hairy tongue.

CHEMICAL BURNS

The escharotic action of the drugs used either as mouthwashes or for topical application, or the idiosyncrasy of an individual to such drugs, may produce lesions that are at times extensive and unusual in appearance, and, most often, so painful that their treatment must take precedence over that of Vincent's infection (Figs. 11-21). The general practitioner who usually sees few such cases is apt to be uncertain of the diagnosis and worried by the untoward appearance of the lesions. Treatment of such burns consists essentially in the discontinuance of the use of the drugs responsible for them. Various aniline dyes may be applied topically to prevent secondary infection, and a mild alkaline antiseptic mouthwash prescribed for frequent rinsings. Besides, spicy or hot foods are temporarily prohibited and the patient is limited to a liquid diet. Resolution is usually rapid and uneventful.

Fig. 15.—White patch on upper gingiva in mouth affected by acute Vincent's infection. The appearance of this patch caused considerable worry to the patient, a physician, as he thought it was due to necrosis. It also simulated a chemical burn, but was actually only a thin deposit of soft food, which remained undisturbed because the mouth was deprived of function and hygiene through the patient's forced disuse of hard foods, temporarily. When this was wiped off with a piece of cotton, the underlying mucous membrane was intact and normal in color.

HAIRY TONGUE

According to the literature, the causes of hairy tongue are quite varied. Among those given are: the presence of microorganisms, trophic disturbances, the use of drugs, gastro-intestinal disturbances

Fig. 16.—Slight edema of lips resulting from frequent use of sodium perborate mouthwash. (When some of the wash is permitted to remain on the lips, it becomes highly concentrated through the evaporation of the water, and the residue is sufficiently irritating to cause edema.) This condition is especially painful when the corners of the mouth are affected. If the condition is mild, the patient is merely warned to clean off the solution from the lips with a piece of water-soaked cotton after each rinsing; if it is aggravated, he is advised to discontinue the perborate wash temporarily. There are small pieces of cigaret paper adhering to the lips on the left side. The patient should be warned that if this happens often, it may invite malignancy through continued traumatization of the epithelium.

Fig. 17.—Chemical burn of lips (photographed at School of Dentistry, Columbia University). This patient was influenced by an advertisement to use a certain preparation of sodium perborate for inflamed gums. The lining of the cheeks and lips became a heavy mass of necrotic tissue within a few days. After the perborate wash was discontinued, the burn healed rapidly. Although the solution used (1 tablespoonful to the glass) is easily tolerated by the average person, clinical experience indicates that about 20 per cent of patients cannot use the drug stronger than a teaspoonful to three-quarters glass of water, without sustaining a burn of a greater or less degree.

and the reaction of the lingual mucosa to radiation of adjacent tissues. Most of the cases of hairy tongue that have come to my attention seem to have been caused essentially by the intensive use of sodium perborate incidental to the treatment of Vincent's infection (Figs. 22-24). Doubtless, the relationship between certain oxygen-liberating mouthwashes used and the resultant hairy tongue must be apparent to some practitioners who have frequent occasion to treat this infection. Various

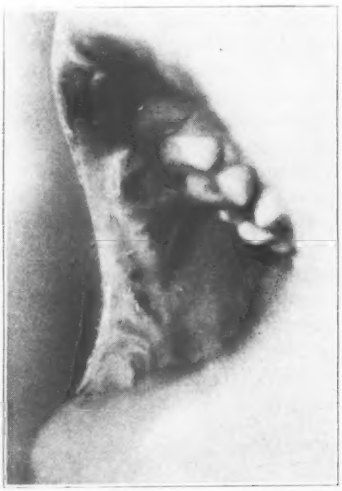

Fig. 18.—Chemical burn produced through use of a 0.5 per cent solution of chromic acid as mouthwash in treatment of acute Vincent's infection. The cheeks, the tongue, the floor of the mouth and the lips, especially in the folds, were affected; in fact, the entire oral mucosa was covered with large white raised necrotic, hard masses of tissue, of which the base was extremely tender to the touch. It was all intensely painful, much more so than the lesions of the original Vincent's infection. The palatal gingivae, too, were swollen and presented necrotic, white lesions. The right cheek was swollen over the upper and lower jaws as was the submaxillary gland on that side. The sublingual glands were raised and hard and the mucosa over them was white. The soft and hard palates, except near the gingiva, remained unaffected. The patient had alternated the chromic acid solution with sodium perborate which was used as hot as she "could stand it." There is no doubt that the extreme heat may have been an additional factor in the initiation of these lesions. (Photographic records show similar lesions produced, evidently, only through the use of very hot sodium perborate.) The traumatizing mouthwashes were discontinued and replaced by a bland alkaline solution. The lesions were treated topically with a dye. Recovery was quite rapid and uneventful. As the masses of necrotic tissue sloughed and were wiped off one by one, the pain and swelling steadily decreased.

writers on hairy tongue have referred to the irritating effect of such chemicals on the filiform papillae, as a result of which they become hypertrophied and hornified, which gives them grossly a close resemblance to hair. Microscopically they are completely different (Figs. 25-26).

Hairy tongue, sometimes called "black tongue," or "lingua nigra," is an abnormal or pathologic condition presenting a brownish patch of discolored elongated filiform papillae, situated on the dorsum of the tongue, generally in the center, immediately in front of the v-shaped line of circumvallate papillae, and extending forward to within about an inch of the tip of the tongue. Although it is light in color near its edges, the patch becomes darker toward the central posterior part, in some instances assuming a discoloration so deep as to justify the descriptive name, black tongue. Clinically, this should be differentiated from discoloration of the tongue which on close investigation shows no hypertrophied filiform papillae or so-called "hairs."

Fig. 19.—Case shown in Figure 18. A close view is shown of one of the rigid and semipedunculated lesions. Originally white, the center is here shown stained by the dye twenty-four hours earlier.

The discoloration and sliminess of these hypertrophied, anteriorly inclined, papillae give the picture, as a whole, the appearance of a patch of wet fur (Fig. 24). When the papillae are brushed up, it can be seen that they are dark at the tip and light gray or white at the base (Fig. 22). They become longer as they approach the central and posterior parts of the patch, but vary in different individuals. In one of the cases herein presented, the papillae attained the length of three-quarters inch (Fig. 24).

Fig. 20.—Case shown in Figures 18-19. There are burns on the gingivae and in the fold of the lip.

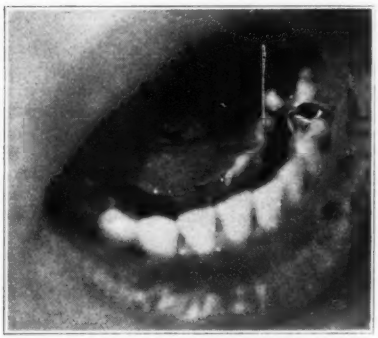

Fig. 21.—Case shown in Figures 18-20; a burn on the floor of the mouth.

A condition of "hairy" tongue entails no serious consequences and is of a transitory character. Nevertheless, on many occasions, it may become a source of annoyance or even of worry to the patient,

especially if he fears malignancy. The literature on the subject does not show any case of hairy tongue as a precursor of malignancy. In some instances, the patient, erroneously associating the condition with a possible gastro-intestinal disturbance, vainly subjects himself to various types of laxatives, and frequently the family physician, who may be unfamiliar with Vincent's infection of the mouth and the possible sequelae of its treatment, is at a loss to account for its appearance in a patient who gives no history of ingestion of drugs and shows no apparent indication of a systemic disorder.

Generally speaking, "hairy tongue" has been known to appear spontaneously, to resist, in some instances, all attempts at treatment, and to disappear without any treatment just as suddenly and unaccountably as it appeared. Usually, it does not call for treatment, and when it is associated with Vincent's infection, it disappears automatically very soon after the discontinuance of the anti-Vincent mouthwashes. When the papillae have attained a certain length, they may tickle the palate and cause nausea. They may then be considerably reduced, and at times entirely eliminated, by a method outlined

Fig. 22.—"Hairy tongue" of kind frequently seen after sodium perborate has been used for several weeks as mouthwash in treatment of Vincent's infection. The dark brown, hypertrophied papillae were brushed up to show their length and the light color at the base. In spite of the length, approximately a quarter inch, the patient was completely unaware of their presence. The tongue in this illustration and those in Figures 23-24 were seen in men between 30 and 38 years of age who were fond of liquor and smoked heavily, and, in each case, the hypertrophy of the papillae on the tongue developed during an intensive course of rinsing with sodium perborate.

by Prinz,[4] through the careful use of salicylic acid, as follows:

> In mild cases of the genuine type, the thorough swabbing of the discolored patch with pure hydrogen peroxid (3 per cent) followed by a warm physiologic saline solution will promptly relieve the condition after several treatments. In the more severe cases, a 10 per cent solution of salicylic acid in a mixture of equal parts of alcohol and glycerin, applied on a swab, acts as an effective keratolytic agent, which will dissolve the corneous papillae. It should be followed by the H_2O_2 application and salt water, as stated above."

readily obtained from the comprehensive writings on the subject by Box,[5] Smith,[6] Merritt[7] and others. Practically every dental and medical periodical contains a description of some new cure or so-called panacea. The fact that so many successful means for the reduction or elimination of the infection are reported leads one to feel that very little pharmaceutic action is required for the control of whatever micro-organisms are actively associated with the disease. Without

Fig. 23.—"Hairy tongue" associated with the use of sodium perborate. The hairy patch was comparatively small, but some of the papillae were very heavy and had thin offshoots sprouting from their tips. These can be seen particularly well in the illustration, on the right side of the median line.

TREATMENT

Lack of space does not permit of a detailed review of the various methods or therapeutic means employed in the treatment of Vincent's infection. This can be

4. Prinz, Hermann: Some Common Diseases of Oral Mucous Membranes and Tongue, D. Cosmos, 69:60 (Jan.) 1927.

5. Box, H. K.: Necrotic Gingivitis, Toronto: University of Toronto Press, 1930, pp. 45-59.

6. Smith, D. T.: Oral Spirochetes and Related Organisms in Fuso-Spirochetal Disease, Baltimore: Williams and Wilkins Co., 1932, pp. 59-63.

7. Merritt, A. H.: Vincent's Infection: Etiology, Diagnosis and Treatment, J. D. Res., 13:55-59 (Feb.) 1933.

underestimating the medicinal value of the arsenicals and the oxygen-liberating or other drugs successfully employed, I am inclined to feel, from personal clinical observations, that successful treatment depends at least as much on the raising of the local and general resistance as on the attenuation, directly, of the micro-organisms by the drugs; and, furthermore, that often the character of the drug used is probably of less consequence than the manner of its application. In other words, the more thoroughly the washes and topical applications are used and a hygienic condition and stimulation are thereby maintained, the greater the tendency to an almost spontaneous resolution of the symptoms, especially when they are acute. On the other hand, when the same drugs are used haphazardly and the local irritants or the debilitating systemic influences are not removed, treatment meets with proportionate resistance. Complete and final success is not attained, no matter what drug is employed, until such deleterious factors are eliminated or reduced.

The aim, in each topical application of the drug, is threefold: (1) to deposit it in the affected area for bacterial reduction, (2) to remove lightly all easily detachable necrotic tissue and the food débris which acts as an irritant and (3) to mildly stimulate the tissue. Similarly, the frequent rinsing with the mouthwash, thoroughly carried out, not only affects the micro-organisms directly but also insures effective oral hygiene, thus minimizing local irritation and reducing the pabulum for bacterial growth. In addition, the alternating compression and expansion of the gingival tissue through

Fig. 24.—"Hairy tongue" associated with use of sodium perborate in anti-Vincent's treatment. The papillae were approximately three-quarters inch long. After two treatments, three days apart, according to the method recommended by Prinz, they began to shed and were readily wiped off with gauze.

the pumping action of the rinsing process has a decided nontraumatizing massaging influence on the local circulation. With the partial subsidence of the acute symptoms, the reduction of direct mechanical irritants, such as calculary deposits and overhanging prostheses, severe traumatic occlusion and food impaction, hastens the resolution of the symptoms. If this is not done, the areas neglected in this respect are the last to respond to treatment—a fact demonstrated clinically again and again.

cous membrane lesions react more favorably to bland than to acid or other irritating solutions.

SUMMARY

1. The hypertrophic form of Vincent's infection occurs sufficiently often to make the descriptive term "atypical" inadequate and to justify the classification of Vincent's infection into two types, the destructive and the hypertrophic.

2. It has been demonstrated that in the diagnosis of a Vincent's infection, neither a positive nor a negative bacterial finding is an absolute guide. A clinical differential diagnosis is, therefore, imperative.

3. A subacute or chronic Vincent's infection is liable to be overlooked in many instances because the objective symptoms are comparatively mild. Hence, a knowledge of individual incipient symptoms, or combinations of such symptoms that point to, or at least are highly sug-

Fig. 25.—Hairlike filaments removed from patch on tongue illustrated in Figure 24. This photomicrograph was made for the purpose of showing the structural differences between them and actual hair (Fig. 26). The former presents a broken, uneven surface because of the projection rootward of the cornified scales, not unlike the barbs on a root-canal broach. (Photomicrograph by Edmund Applebaum, Histology Department, Columbia University Dental School.)

In general, escharotic drugs used either topically or in strong solution as a mouthwash, also mouthwashes that are extremely hot, are contraindicated. Not only is treatment apt to be retarded, but, as shown earlier, vicious looking ulcers may be thus produced, the burned tissue being defenseless against the invading organisms. Therefore, in the selection of drugs, one should bear in mind that mu-

gestive of, that infection, is obviously advantageous.

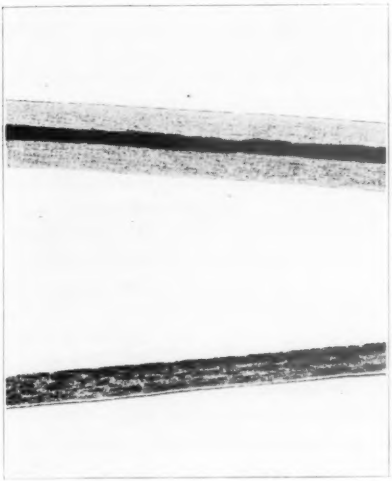

Fig. 26.—Human hairs; thinner one, dark brown; other, reddish gold, made under same magnification as Figure 25, to show comparison in thickness and structure between them and hypertrophied filiform papillae in hairy tongue.

4. Two clinical entities occasionally found associated with Vincent's infection, but which must be differentiated from it, are chemical burn and "hairy tongue." These may be produced by the drugs used in the treatment of the infection.

5. Various clinical observations indicate that successful treatment of this disease depends at least as much on the raising of the general and local resistance as on attenuation, directly, of the microorganisms by the drugs employed.

6. In answer to a questionnaire regarding the choice between the topical and the intravenous use of arsphenamine in the treatment of Vincent's infection of the throat, a group of outstanding otolaryngologists replied to the effect that, in the usual case, the local application is desirable and sufficient, but that it is well to supplement it by intravenous therapy in more severe or complicated cases. In the experience with the drug here reported in the treatment of the infection in the mouth, its local use has always sufficed.

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THE EVOLUTION OF MECHANICAL TREATMENT OF MALOCCLUSION*

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TO trace the evolution of mechanical treatment of malocclusion, it is necessary to trace the development of knowledge pertaining to the subject, for orthodontic appliances, like most other man-made instruments, have been evolved in response to a need.

History has not recorded the beginning nor all that has been done, but, for the past two centuries, the records are sufficiently near completeness to enable one to follow the developments which have led to changes in theory and practice and thus changes in mechanisms and their manipulation. A review of these records reveals the fact that, up to the latter part of the nineteenth century, obviously because of lack of knowledge pertaining to

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the subject, expansion without regard to landmarks, fixed points, esthetics, etc., constituted the problems of correction of malocclusion, and that to this end, whether applied outside the dental arch by means of traction or from within to create a push force, the simple machines were employed. The lever, inclined plane, screw and, occasionally, the pulley were applied to this problem of expansion and, in general, their introduction and application constitutes the evolution of mechanical treatment of malocclusion during this early period.

The first appliance of which there exists any record was the bow or bandelette of Fauchard. This appliance embodied the principle of second and third class levers and, even though it has been modified and refined, was in principle the same as the present-day expansion arch. It consisted of a strip of flexible metal in width, somewhat less than the height of the teeth to which it was attached, and its length was dependent on the work at hand. Holes were made at each end for the reception of thread ligatures, by which means it was attached to the teeth. It was applied to produce a push force and its position outside or inside the arch depended on the position of the malposed tooth or teeth. Bourdet extended the use of this arch when he made it to extend around the circumference of the arch from the second molar on one side to the same tooth on the other side and instead of employing it to produce a push force used it to apply traction. The next mechanical principle, which we find applied to the expansion problem, was the inclined plane. This principle, introduced by Hunter, originally was employed to produce individual tooth movement, but like the principle of the bow, its use was extended by designs which caused groups of teeth to react to its force.

It seems that the use of these machines met the demands of treatment quite satisfactorily, for many years elapsed before any other mechanical principle for the production of force was introduced. Of course, various applications of these principles were made, which resulted in the designing of numerous appliances, but these designs were a matter of individual opinion and they did not alter the fact that the same principles were used.

Some time near the middle of the nineteenth century, the screw was introduced as a means of producing force. Its introduction did not cause existing appliances to be discarded, but, in addition to being incorporated in their designs, it resulted in new appliances based upon its principle. The jackscrew, originally employed to move single malposed teeth working from a single larger or more favorably located tooth, developed into more complicated forms, and eventually a series of jackscrews working from a common base and stabilized by equal and opposite pressures came into use, constituting a distinct class of orthodontic mechanisms. One form of these appliances consisted of double clasps on the molars and bicuspids, connected by a threaded straight wire, soldered to the clasps of one side, which engaged a tubular bar threaded inside, and soldered to the clasps of the opposite side, thus permitting an adjustment for lateral expansion. To this straight connecting bar were attached individual jackscrews for the forward movement of the anterior teeth.

We cannot assume from the records that the jackscrew introduced the question of anchorage, but certainly we are led to believe, from their application and manipulation, that they contributed to the recognition of the importance of the problem, for, following their introduction, we find the plate, both metal and vulcanite,

used as a base from which wooden pegs and screws supplied the force for movement of individual teeth, and, later, the vulcanite plate, extensively employed to effect group movement in lateral expansion. Following this came the use of the crib, not as it had been used before, for holding teeth apart, but for grouping teeth to gain mass anchorage. The teeth were clasped and the clasps connected with a lingual bar as a base from which to apply force.

This marks the ultimate refinement of appliances working from within the arch until the time when bands were first cemented to the molar teeth as anchorage.

During the time that these developments were taking place, there were men who continued to work from the labial aspect, and we find that the changes are mainly or entirely refinements of the bow principle of Fauchard. As previously stated, Bourdet had extended the use of the principle, but after Bourdet's use of the arch, no changes were made, until Fox, considering it expedient to hold the teeth apart, attached to it at the posterior ends a block of ivory, to prevent the teeth from closing. This idea prevailed for many years, and all appliances were designed with some such arrangement. Delabarre, instead of using the ivory block, designed a wire crib, which was placed over the lower molars to serve the same purpose. This crib, even though it did not enhance the value of the expansion arch, as used at that time, was later used to advantage in combination with the expansion arch and in this capacity served a useful purpose. One of the difficulties encountered in the use of the expansion arch from the beginning was the need for constantly extending the length of the arch to meet the ever increasing demand for expansion. The crib and clasps became employed much the same as those described in connection with lingual appliances to obtain anchorage. With these as a base for operations, Evans used spiral springs working against projections on the cribs to feed the arch wire forward. For contraction, the spring was employed to draw the arch wire distally. It was but a step from this to the development of the molar attachment, consisting of tube, threaded arch end and nut, providing screw force for the advancement of the arch, which has been an integral part of almost every labial appliance.

From all of the foregoing, it is readily seen that the objective in regulating was to expand the arch and push or pull teeth into some sort of even arrangement to increase their masticatory efficiency or to improve esthetic values, but that the biologic significance of the work had gone almost wholly unnoticed.

It was in this empiric field that we find Edward H. Angle working with the instruments and knowledge that was his heritage from the pioneers and his coworkers in orthodontia, but destined to become the acknowledged leader and honored as the "founder of scientific orthodontia." In 1887, he read his first paper of importance before the Ninth International Medical Congress and introduced the first system of appliances, thus fulfilling the prophecy made by Dr. Farrar in 1878 that the time would come when the regulating process and the necessary apparatus would be so systematized and simpified that the latter would actually be kept in stock, in parts and in whole, at dental depots, in readiness for the profession at large, that it might be ordered by cataloged numbers to suit the needs in any case, and that, by a few moments' work at the blowpipe in the laboratory, the dentist would be able, by uniting the parts, to produce any apparatus, of any size desired, at a minimum

expenditure of time and money. Angle's appliance consisted of a smooth ended arch, tubes, nickel silver band material, jackscrew and traction screw. We can easily imagine that when he entered the field, his concepts were much the same as those of other men, as indeed his first system of appliances show. That he met the same difficulties is attested by the fact that one of his first improvements, after the clamp band, was a means of extending the arch similar to that of Evans, namely the tube, threaded arch and nut, and this was further improved by the introduction of the friction sleeve nut to prevent the arch from "creeping."

This was the beginning of a systematized and standardized mechanical development which, for the next forty years, was dominated by Dr. Angle. Practically every advance in the field of mechanics originated with him. In order to understand the significance of his contributions and the reasons for their introduction, it will be necessary to trace side by side both his inventions and the concepts of the problems of orthodontia that led to them.

With all mechanisms in use up to this time, including those used by Dr. Angle, force was applied in any manner that would make teeth move, and anchorage had been gained only by pitting a larger tooth or a number of teeth against a weaker member. In 1887, Dr. Angle introduced the principle of stationary anchorage, thus recognizing the fact that each tooth, through mechanical manipulation, might be capable of varying degrees of resistance. He had discovered the fact that, if the attachment to an anchor tooth was of a simple or contact nature, and the tooth moved on the application of pressure, this movement was the result of a tipping motion. He found that by so modifying the mechanical attachment that, if the tooth moved, it had to move bodily, the resistance which it offered to movement was materially increased and therefore became more valuable as a base of operations. From this time, we find anchorage assuming a more and more important place in the thought of the profession.

To further increase the efficiency of the expansion arch, various improvements were made from time to time. Among these should be mentioned Magill's application of the cemented bands to teeth other than the molars, to which the arch, spurs or spring levers could be applied so that more positive attachment to the tooth could be gained for rotation, etc. The arch itself was modified, and we find that Dr. Angle experimented with the heavy inert as well as the light springy material.

During all of this time he was studying, observing and correlating, and the results of these labors were an ever-widening concept of the problems. In 1899, he made what was probably the most significant single contribution ever made to orthodontia; namely, the classification of malocclusion. The effect of this was to elevate a chaotic field into the realm of a science and, at the same time, to increase enormously the demands on the efficiency of all appliances. It now became necessary to think not only in terms of tooth relationship, but also in terms of jaw relationships. Dr. Angle found, as did his co-workers, that the available appliances were incapable of performing the work that his theories, which were generally accepted, demanded. The demand on anchorage was enormously increased, and we find men going outside the mouth to occipital anchorage to meet this demand. Baker's principle of intermaxillary anchorage was also generally accepted.

Between the years 1895 and 1908, practically all efforts were directed to-

ward the refinement of the expansion arch E, and the results which were obtained by the use of this very simple mechanism would excite the admiration of any user of a modern so-called complex mechanism. It was in the handling of this mechanism that the profession grounded itself in the principles of anchorage, normal occlusion, esthetics and all the known problems of orthodontia, but the more they learned of the denture, its growth and development and the forces that bring it into harmony and balance, the more they were chagrined by its inefficiency and their inability to leave cases in the condition which they knew to be normal.

Having only simple anchorage at their disposal for the control of the anterior teeth, they were frequently faced with that orthodontic monstrosity, the "toothy" case, but it was from one of these cases that Dr. Angle received the inspiration that led to all of his subsequent appliance developments. This particular case presented a marked flaring of all the teeth at the end of treatment, but, on subsequent examination, it was found that, without losing any of their cuspal relationships, the teeth, through function, had righted themselves and were standing upright. Dr. Angle reasoned that if the apices of teeth were able, through functioning forces, to move through bone or carry bone with them, it should be possible by means of light mechanical force to move them in like manner. Immediately after this discovery, he introduced the working retainer. The device was made by removing the segment between the threaded ends of the expansion arch that had been employed in accomplishing the movement of the teeth, and substituting for it a segment of the same length and curve, of very delicate and elastic iridioplatinum and gold wire, twenty-nine thousandths inch in diameter, and attaching the ends of this wire to the threaded ends of the original arch with 22-carat gold solder. Very small tubes were soldered perpendicularly to the labial surfaces of delicate iridioplatinum bands previously fitted to the crowns of the incisors. These tubes were parallel with each other, their incisal ends resting in contact with the middle segment of the arch.

Very delicate spurs, of the length and diameter of the bore of the tubes, or twenty-two thousandths inch, were soldered to the arch at points opposite the mouths of the tubes when the arch was in position. The ends of the spurs were then gently inclined forward about three thirty-seconds inch by bending; the arch replaced on the teeth, and the spurs sprung into the tubes. Thus, a gentle force from the elasticity of the spurs and arch combined to give a stimulating pressure labially on the roots.

This was the first application of the arch directly to the anterior teeth in such a manner that stationary anchorage could be obtained. It was but a step from this point to the introduction in 1912 of the pin and tube appliance, which made use of the same principle in active treatment. This appliance consisted of a modified E arch divided into three parts: a middle section and two end sections. The end sections were threaded and provided with friction sleeve nuts. The middle section was smooth, with square ends which accurately telescoped for a distance of about one-eighth inch into square sockets in the anterior end of the threaded sections. The reason for this form of arch was that it made possible the use of a middle or anterior section of any length or diameter desired, interchangeable with the threaded sections. Three lengths and three diameters were used, which were ample to provide a sufficient range of size and

strength for all dentures. The larger sizes, namely, thirty-eight thousandths and forty-five thousandths, were used in connection with wire ligatures the same as were used with the standard expansion arch E, thirty thousandths being used in conjunction with the tube attachments. The attachment of the arch to the teeth to be moved was accomplished by means of delicate pins, soldered directly to the arch, which engaged tubes soldered to bands on the teeth. In spite of the fact that this appliance marked a forward step in orthodontic treatment, for with it was gained not only better control of force for crown movements of teeth, but also the proper control and distribution of force for the movement of roots, it was soon found to have disadvantages as well as advantages. Among other things that caused its abandonment was the extreme difficulty of its assembly and manipulation and the fact that the teeth were fixed in their positions on the arch.

It is to be noted that Dr. Angle was not the first to recognize the necessity of root movement. Dr. Case and Dr. Farrar, before the close of the nineteenth century, had recognized the need and devised appliances to accomplish this movement. Their theories were opposed. While Dr. Angle attempted to develop bone through the use of light, steady pressure, they attempted actual displacement of bone through the use of heavy arches and screw force. We gain this information not alone from reviewing the appliance construction, but from Case's remarks that the bones do not remain stationary to be plowed through by the roots in a process of retrogression metamorphosis, but that a considerable portion of the bone in which the teeth are embedded is carried with the roots in proportion as they are changed in position. The appliance used to accomplish this transposition consisted of two labial arches, each equipped with screw force. One of these occupied an incisal position, the other was placed gingivally. In later years, when the necessity of root movement became generally recognized and when the mechanics of bone change became better understood, the E arch with spur auxiliaries was made to accomplish the same purpose as the twin arches. This was done by soldering spurs to the arch, which was adjusted at the gingival aspect, and having the ends of these spurs rest against the incisal edge of the teeth. By adjustment of the spurs and ligation of the arch, root movement was accomplished.

While these developments in labial design were going forward, the interest in lingual type mechanisms continued. Dr. Angle and J. Lowe Young contributed to their advancement by the development of an attachment, known as the Angle-Young lock, to be used with cemented molar bands. This gave rise to the development of a semiremovable type of lingual appliance, the principle of which is the use of a base wire attached to the molars for anchorage. From the base wire, auxiliary springs are employed to produce tooth movement. By the ingenious use of other auxiliaries, effort has been made with this appliance to answer the demands of treatment. So numerous are these auxiliaries, time will not permit a detailed description of them. It is sufficient to record the principle of the mechanism, for, regardless of the modifications, the principle has remained the same. This appliance, from its introduction, has enjoyed wide popularity, but because of its limitations and inefficiency, it is gradually giving way to appliances which possess greater possibilities for anchorage and effectiveness.

Another lingual design based on the

crib as an anchorage attachment was developed by Victor Hugo Jackson. This has been modified and used in various forms, such as the Bacon appliance, but the inability of these appliances to meet the new demands in treatment has led to their almost complete abandonment.

Going back to the labial designs, Dr. Angle, in 1916, introduced the ribbon arch mechanism to overcome the faults that he and others saw in the pin and tube appliance. The ribbon arch had several advantages; namely, it did not require such an exacting technic; it permitted the freedom of the teeth on the arch, and, finally, it better interpreted the demands of the newer requirements of treatment. To understand this last point, we shall have to review for a moment the various methods that had been tried in the treatment of Class II cases.

The first of these methods, advocated by Kingsley, consisted of expanding the maxillary teeth, retracting the anterior, and then jumping the mandible forward the entire distance. This method failed because it pulled the head of the condyle out of the glenoid fossa and stretched the ligaments, and these again retracted the mandible when the appliances were removed. After Angle had published his classification, it became apparent to everyone that if in Class II there was a distal position of the mandible, the aim in treatment must of necessity be the bringing forward of this jaw. Kingsley's method seemed correct theoretically, and Angle used it for a time, but became skeptical of it on account of the great number of relapses.

Having realized the extreme importance of normal inclined plane relationship in development, Angle sought to establish this condition by his treatment, and the second method was advanced, i.e., that of tipping the maxillary teeth back and the mandibular teeth forward until each tooth met its proper antagonists. This method likewise failed, for, with the appliances at hand, the teeth were left at too great an inclination and the forces of occlusion could not exert themselves sufficiently to produce the desired development of the mandible.

The third method, advocated by the late Dr. Dewey, was to expand the maxillary denture, retract the anterior teeth, and then develop the mandible by moving the mandibular teeth forward. Theoretically, this is the ideal, for it is the goal toward which all treatment in these cases is directed. The difficulty is to develop the mandible with a mechanical force. With his tipping method, Angle had noted the relative ease with which he could move maxillary teeth as compared to those of the mandible and, still believing in the ability of normal function as an agent of development, he now decided to move the maxillary denture back the entire distance to coincide with the underdeveloped mandible, subsequently depending on normal function to bring the entire denture to its normal relationship with the cranium. To accomplish this distal movement of the maxillary teeth, the lower metal arch is so placed that it causes the dental arch to act as a unit of stationary anchorage. This is accomplished by placing a twist or torque in the metal arch in the incisor area and a gingival bend anterior to the molar. In the upper jaw, this same procedure is followed as far as the incisors are concerned, and when the elastics are applied, the entire lower arch and the greater part of the upper arch are pitted against the upper molars, to which screw force is applied.

This appliance made possible more definite control of tooth movements with the least expenditure of time and effort

of all appliances devised up to this time; for, with the bracket attachment, there is gained unlimited anchorage possibilities. With this appliance, as with all that had gone before it, Dr. Angle was dissatisfied, his main criticism against it being that it required the movement of first the molar, then the bicuspids, then the cuspids, and finally the incisors, and he felt that this should all be done at the same time. Furthermore, the form of the bracket and the direction of application of the arch made it impossible for him to obtain the type of control over the bicuspids that he desired.

As early as 1915, he was experimenting with various other arch applications, notably the side entrance bracket, but it was not until 1925 that the edgewise arch mechanism was introduced to a few of his followers, and it was 1928 before it was given to the profession. This mechanism gives control over all of the teeth in three planes of space and it has other advantages not found in former appliances. It permits not only individual tooth control, but also mass movement, even to that of an entire arch in one direction. With the E arch, ribbon arch or any other mechanism used for mesial or distal movement of teeth, the principle is to move teeth individually along an arch which acts as a fixed base. This same plan may be used with the edgewise arch wherever desired, but, with the edgewise arch, it is possible to move the entire arch mesially or distally without changing the relation of individual teeth to each other, or to the metal arch, for the arch travels with the teeth.

The principle of the arch traveling with the teeth (which makes possible mass movement) is accomplished by the use of levers and is dependent on the physiologic principle that when a tooth tips, it moves with the fulcrum at the root apex. This method of moving teeth has been variously called "phalanx movement," "second order movement," "tip-back movement," etc., and the technic involved has been described by various writers during the last five years; therefore I shall not repeat it here. Suffice it to say that it depends on the action of a series of reciprocating levers, lying in the same plane. It is to mesiodistal movement what torque is to labiolingual movement and it depends on precisely the same tissue reactions for its effectiveness. Like torque also, it can be used for anchorage instead of tooth movement, and this has added enormously to the effectiveness of the appliance. The molars are no longer overworked for this purpose, because every tooth banded means that much more stationary anchorage.

We see in the edgewise arch the return of an old principle, namely, the ideal arch. In many cases, the mechanics resemble those of E arch treatment, since the teeth are brought out to a form created at the beginning of the work. This ideal arch is not a manufactured article as was the expansion arch, but a bar of springy metal formed according to the anatomic form presented by the teeth. Like all other spring force, this gives greatly extended range, but introduces the penalty imposed by all springs, that of thinking carefully in terms of reaction as well as of action.

It should not be thought that Dr. Angle was the originator of all these applications. As we have seen, he was not the first to move anterior teeth bodily. He was the first to throw this bodily control into a horizontal plane of space by the use of a flat-sided arch in an accurately fitting braket, but he was not the originator of the flat-sided arch. His great contribution lay in the correlation

of mechanical and biologic principles to the problems of malocclusion and to the systematizing and standardizing of methods and appliances.

Recently, there have been introduced other new forms of mechanical devices for the correction of malocclusion. Analysis of these appliances reveals the fact that they do not embody any new principles, but that they, like the developments in the last fifteen or twenty years, are based on the principle of the expansion arch, cemented band and some form of bracket control.

Since in the use of the edgewise mechanism, while the jaw relationships are being corrected, other positions of malocclusion are being cared for, such as rotation, elevation, depression, and labial or lingual movement, it would seem that the ultimate has been reached in the control of individual teeth in relation to each other and in the control of relationships existing between arches. It should be pointed out that the goal has not been reached in controlling the entire denture in relation to the cranium and the rest of the body, and that it is entirely thinkable that many relapses of the present-day cases treated with highly efficient mechanisms may be due to this specific lack of control. It is going to be necessary to continue the study of dento-cranial relations until we have a clear-cut picture of these relationships at various stages of life, and then the means must be devised that will enable us to place the entire denture where it belongs in space.

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FUNDAMENTAL FACTORS INVOLVED IN BRIDGE PROSTHESIS*

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IN problems of health, prevention and function, the restoration of edentulous spaces assumes a vastly more important aspect and must of necessity involve considerations biologic and pathologic, as well as mechanical.

The dentist of today, in order to meet the demands of modern dental practice, must recognize and deal with conditions of the oral cavity which are in many cases closely allied to, or the direct cause of, systemic disease.

Treatment, to be successful, must depend on diagnosis. Consequently, the initial step, prior to the beginning of any dental reconstructive or restorative work, should be a diagnostic study comprehensive enough to include, in the final analysis, all the important deviations from the normal presented by the patient, arranged and recorded in their order of relative importance.

Diagnosis has been defined as "the sum total and correlation of the history, the clinical findings and the results of the various specialized methods of examination, or in other words the determination of the distinctive nature of a disease." Since the correctness of an oral diagnosis also depends on the proper evaluation of symptoms, signs and data, carefully correlated and interpreted with critical care and judgment, the examination, which is part of the diagnosis, must be made in a

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systematic, exacting manner, so that nothing will be omitted or overlooked. The observations and symptoms should be carefully recorded and should include a systemic and oral examination sufficiently comprehensive to meet the requirements of the case. If the patient's condition is of such nature as to require a more comprehensive systemic examination, he is best referred to his physician, who should report his findings and cooperate with the dentist when his services are needed.

Oral diagnosis is concerned not alone with the determination of diseased conditions and their causes, but also in the change from normal in the function of the organs of mastication resulting from the loss of teeth, malocclusion or disease.

The treatment decided on from a carefully correlated diagnosis must involve the prophylactic, therapeutic, surgical and operative procedures necessary before or during the process of reconstruction and restoration. The factor of safety in the tissues, the power of regeneration, the effects of trauma and the lack of occlusal coordination are parts of a functional concept which change our views as to treatment, and give us a different opinion as to the possibilities of health service and prevention when adequate treatment is applied.

Probably the greatest barrier to the successful practice of bridge prosthesis is due to failure to recognize the importance of establishing and maintaining occlusal coordination, and disregarding the destructive sequences resulting from traumatic occlusion.

Since traumatic occlusion is generally considered an acquired condition which may exist in mouths requiring the restoration of edentulous spaces, or may result from the presence of bridges which do not function in harmony, it is evident that occlusal coordination, in harmony with mandibular guidance, should be obtained before the bridgework is begun. Furthermore, the bridge supplied must be so designed and constructed that its occlusal surfaces will function in harmony with the previously established functional occlusion. Occlusal coordination is, therefore, fundamental to crown and bridge prosthesis from a physiologic standpoint and involves the application of the principles of applied mechanics to those biologic in nature.

In order to obtain satisfactory results in both reconstructive and restorative procedures, it is basically essential that an anatomic articulator and working casts be used, with hard study. The problems involved in the study and restoration of occlusion cannot be solved by arbitrary methods, but must include the application of scientific principles in order to ascertain the true relationship of the condyle paths to the occlusal plane.

The study and working casts must be correctly oriented to the articulator, which must be adjusted to correspond with the movements of the individual patient. Not only are the casts so mounted of value for diagnostic purposes, but they should also serve as a guide during the procedure of occlusal adjustment, and as an aid during the construction of the bridge.

The sculptor uses a model from which he creates his masterpiece. Why then is it not just as important for the dentist to have a working cast made from impressions taken of the natural teeth of the patient, on which to design the restoration and sculpture the occlusal surfaces and tooth form? Infinite variety in the things she produces seems to be the goal of Nature. Exact duplication, on the contrary, the goal of man's production efforts, and his nearest approach to perfection in making two things identical is perhaps his highest achievement. Each product of Nature's workshop reaches its

final form through a process of growth, during which its parts exist in active relationship to one another. The ideals and fundamentals which determine the design of a restoration should in the final analysis be based upon Nature's own specifications and plans.

It is a lamentable fact that many bridge failures may be attributed to the use of the small hinge or straight-line articulators, in conjunction with poor impressions and small, and in many instances poor, casts, mounted without any regard for mouth relationships. Just why the same operator will consistently expend time and energy in securing accurate casts, which he carefully orients, with the aid of a facebow, to an anatomic articulator, to be used in conjunction with his denture construction, and then persists in mounting small, inadequate casts upon an old hinge or straight-line articulator for bridge restorations is beyond comprehension.

The proper application of bridge restorations is more than a mechanical procedure. It is dependent on the ability of the operator to correlate and apply certain fundamentals, and implies a correct response to the demands of the patient. The problems involved are varied and present many difficulties which cannot be solved by the restricted use of any one type of bridgework. Both fixed and removable restorations have their indications, but the selection of one or the other should not be influenced by a prejudiced or commercially inclined mind. Furthermore, the operator who understands the fundamentals involved realizes that no one method of restoration can be regarded as a panacea for all cases.

Existing conditions are revealed by examination and diagnosis, and these, with the limitations implied by the validity and reliability of the survey, aid in formulating the treatment necessary. The planning or designing of remedial procedures are of vast importance, for the success of the remedial or restorative work depends on the accuracy and details with which the specific skill and constructive effort involved have been achieved by the operator.

It is indeed fortunate that Nature has provided the physiologic processes involved in the oral cavity with a reasonable margin of safety. In other words, for the most part, the various functions are capable of performing more than they are usually called on to accomplish. If the maximum capacity of any function lessens, or is lessened, the margin of safety, or the difference between the maximum capacity and the usual requirements, is likewise reduced and a pathologic condition may result. For this reason, stresses must be kept within biologic safety limits and the mechanics involved must be in accordance with the biologic support. The factor of stress plays a most important part in the life and function of any reconstructive or restorative procedure. The dynamic relationship, the mechanics, as well as the biologic and physiologic aspects must be given due consideration, and every precaution must be taken to prevent the introduction of traumatic occlusion, excessive occlusal impact, or an overloading of the teeth in excess of that which they can biologically or physiologically withstand.

Briefly stated, cases requiring bridge restorations may be classified, according to existing occlusal conditions, as follows:

Group 1 would include all cases wherein functional occlusion exists, and the remaining natural teeth have not changed position; mostly cases of recent extraction wherein no interfering influences have entered to produce traumatic occlusion.

Group 2 would include cases wherein

only slight occlusal disharmony or traumatic occlusion is present and which can be very readily corrected. Such cases may, and in many instances do, have satisfactory centric occlusion, but, in the lateral and protrusive ranges, disclose a limited amount of functional disharmony. Examples of such conditions would be the interference of the cuspid teeth in lateral excursion, or one or more upper or lower incisor teeth in the protrusive ranges. With a slight amount of grinding a free movement of the mandible is provided, the offending teeth are relieved and further traumatization of such a tooth is prevented when used as an abutment.

Group 3 would include those cases wherein there is considerable occlusal disturbance, trauma, malocclusion or other abnormalities, and mouth remodeling or reconstruction prior to placing the bridge is deemed advisable. Some of these cases require grinding such as is outlined by Drs. McCall and Stillman; others, orthodontic treatment; others, surgical interference, and others, various combinations of treatment.

Group 4 would include those cases requiring opening of the bite. Retrusion of the mandible with marked overbite of the upper incisor teeth, excessive wear, end-to-end and prognathous bites are all included in this group. The task of opening the bite is generally an intricate one and should be approached carefully and with a complete knowledge of the requirements of the case and technic involved. Such procedures, approached from different angles, have been outlined by Drs. Maves, Bailey, Tinker, Munson and others.

With these four groups in mind, the initial step is a proper diagnosis of the existing occlusal relationship and a decision as to the degree of correction or restoration practicable. Not all occlusions can be remodeled or the bite opened and a new occlusal plane established, and the advisability or inadvisability of such a procedure must be arrived at after careful study. Furthermore, and especially at the present time, the matter of expense often enters in and the patient for economic or other reasons cannot submit to such extensive treatment. Under such circumstances, it is obvious that a compromise must be made and the best treatment given the patient consistent with existing conditions.

The treatment or restoration of edentulous spaces by means of fixed bridgework requires the restoration of an efficient and functional occlusion in all the ranges of mastication, the preservation of the unity of the arches and the mainteance of physiologic tone of the tissues involved, with due emphasis on the hygienic and esthetic phases. The component parts—the abutments and pontics—must be carefully selected, designed and constructed, for the efficiency and longevity of the restoration is dependent on judgment, careful manipulation during the process of construction and the proper selection of the gold alloys and materials used.

We are all cognizant of the fact that the stability and permanence of a bridge depends primarily on the health, strength, support and environmental tissues of the abutment teeth, and their freedom from undue stresses. The cusps, fossae and inclined planes of the abutments and pontics must be so formed and located that they will function in harmony, and without undue lateral and vertical stresses, not only in centric occlusion, but also throughout the lateral and protrusive ranges of the mandible, resulting from the action of the muscles and ligaments of mastication.

At the present time, there is a wide range of opinion as to the occlusal carv-

ings of abutments and pontics. Flattened cusps, cuspless and inverted cusp carvings are being advocated as a means for the relief of stress. While it must be admitted that they do minimize lateral stresses, we must also recognize the fact that masticating efficiency is greatly reduced and the possibilities for the introduction of abnormal vertical stress or overload are greater because of the flat or otherwise inefficient occlusal surfaces.

A bridge abutment, to be efficient, must be restorative, restoring lost tooth substance, functional occlusion, and tooth form; preventive, protecting the pulp and environmental tissues against trauma and recurrence of decay; retentive, having sufficient inherent strength to prevent the dislodgment or loosening of the bridge. That these requirements are not fulfilled by some of the so-called modern attachments is frequently manifested by recurrence of caries at the margins, or loosening of one or both abutments in a comparatively short time after the bridge has been placed.

There is a tendency, due to a desire to conserve tooth substance, to prepare small, shallow cavities, and construct thin, inadequate abutments with margins not in immune areas. As a result, there is a loosening of the abutment in its entirety or the development of open margins by the distortion or yielding of the abutment. Such conservatism is misapplied, for eventually more tooth substance is lost (the possibilities of pulp involvement being precluded) than would have been necessary had the cavity been adequately prepared at the beginning.

At the present time, three basic types of abutments are in general use: the inlay; the veneer, including the three-quarter, partial and full cast crowns, and a combination of the inlay and veneer types. To these may be added a series of modifications which have been from time to time presented to the profession as advanced ideas in cavity preparation and abutments.

To approach their application and construction without understanding their possibilities and shortcomings is to court failure. The selection of the proper type of preparation or cavity and precision in its preparation are factors of apparent importance, for the faulty preparation of abutment teeth has in many instances precluded otherwise good results.

The fundamental principles of Dr. Black's cavity preparation should be adhered to as closely as possible. The outline form of the cavity should be absolutely definite and sharp, the seats flat and the walls smooth. Particular attention should be given to the extension for prevention phase, especially as to its relation with the abutment margins so that they will be accessible to the toothbrush and receive the scouring effect of food passing over them during the process of mastication. The gingival margin should extend under the free margin of the gum, ample allowance being made for gum recession on the proximal surface adjacent to a recently extracted tooth. Where recession has taken place beyond the neck of the tooth, the gingival outline should terminate just occlusally from the cementoenamel junction. Under no circumstances should the gingival margin be placed just slightly occlusally from the free margin of the gum.

Unfortunately, the inlay has not proved so satisfactory an abutment as had been anticipated. While failures in some instances resulted from faulty cavity preparation and use of short or extensively decayed teeth with thin walls, small and thin layers and soft golds, clinical evidence is conclusive that the inlay abutment does not generally provide sufficient retention or mechanical resistance and is therefore very limited in its application. When used, its application should be con-

fined to strong, vital teeth, at least of average length, in which frictional or mechanical retention will be provided for by two or more parallel axial walls opposed to each other. In conjunction with this, an exacting technic must be used for obtaining an accurate wax pattern and a casting technic which will produce a cast inlay having the right amount of frictional retention without causing undue pressure or compression of the dentin, and will fit accurately.

Because of its gripping qualities, the partial veneer or three-quarter crown is the abutment of choice in many instances. Especially is this true for sound anterior teeth where the minimum loss of tooth substance, and maximum strength, retention and esthetic values are so essential. The fact that some operators attempt to make universal application of this particular type of abutment has resulted in unnecessary failures. In order to produce satisfactory abutments of this type, care must be exercised in the selection of the teeth used, combined with an exacting technic such as outlined by E. T. Tinker.

That the full cast crown affords maximum retention must be admitted, but, from an esthetic standpoint, its use is in many instances decidedly objectionable. On short or bell-shaped and badly broken down posterior teeth, where there is not sufficient tooth structure available on which to secure adequate retention, the full cast crown may be used to advantage. The casting process has materially changed the status of the gold crown. The full cast crown as now constructed requires a minimum loss of tooth structure, does not require removal of the gingival enamel and terminates with a finishing line or chamfered joint, which provides a margin flush and in perfect continuity with the gingival area of the tooth. The wax pattern is easily carved to occlusion and anatomic form with contact points instead of contact surfaces. By compensating for the shrinkage and with a type C crown gold alloy, thin castings can be made which fully meet the requirements where this type of an abutment is used.

It is well at this time to emphasize the importance of pulp protection and conservation. The generation of heat by rapid grinding; the cutting of deep cavities or excessive preparations; trauma, and the placing of large masses of metal in close proximity to the pulp are all causative factors in pulp degeneration. Extreme precaution must be observed with the younger patient because of the larger size of the pulp and incomplete calcification. Where the roentgenogram reveals this condition, some type of removable appliance is indicated which may be worn until a fixed bridge may be placed without endangering the pulp.

The accurate reproduction of tooth form and the paralleling of the abutments are other phases which are quite frequently neglected, resulting in overstimulation or understimulation of the gingival tissues, torque and overhanging and distortion of the margins.

Primarily, the purpose of the bridge is to restore lost teeth, function and esthetic values; which is accomplished by means of pontics. Consequently, among other considerations, a pontic should have anatomic form and strength and should meet the hygienic and esthetic requirements. It should never produce irritation either through roughness or undue pressure, or create spaces in which food may find lodgment, but should be so constructed that it can be as readily cleaned as the natural teeth.

We frequently hear that the occlusal surfaces of pontics should be reduced in size buccolingually in proportion to the length of the span and the strength of the abutments. While this might be a decided

advantage in some cases, in others a reduction in the distances from the crest of the buccal to the lingual cusps would result in inharmonious cuspal relationship with its attending misapplied lateral stresses. Since the distance from buccal to lingual cusp is approximately only one-half the distance from the buccal to the lingual surface at the height of contour, this difficulty can be avoided by reducing the occlusal area and the buccal and especially the lingal surface, enlarging the lingual embrasures, leaving the cusps in their proper relationship and further reducing the stresses by providing adequate grooves or spillways for the escape of food over the marginal ridges.

Such a procedure does not apply to cases wherein lateral stresses have been reduced owing to the flattening by wear or abrasion of the occlusal surfaces. Where this condition exists, other treatment is required, which cannot be discussed because of lack of time.

I have pointed out that most healthy functions are protected by a considerable physiologic margin of safety. It is this margin of safety which accounts for the fact that abutment teeth will tolerate a reasonable amount of additional load strain such as results from the additional occlusal forces from the supplied pontics. In all cases, there is apparently a diminution in the crushing strength or force exerted on the restored side as compared with the normal side in the same mouth. In a series of tests made in our department, this difference varied considerably and, in some instances, was as high as 20 pounds decrease for a bridge with one pontic, in a mouth registering a crushing strength of 85 pounds on the normal side. This clearly indicates that the abutments supporting the bridge are more or less protected and will bear just so much vertical pressure, the patient being warned by the approach of pain when excessive pressure or force is applied. Even though this is the case, clinical evidence demands that we adhere to the practice of limiting the application of fixed bridges to short spans in order that the mechanical forces involved will be in accordance with the biologic support.

The porcelain tipped pontic with its highly glazed surface affords a most excellent means of restoration where there is sufficient space gingivo-occlusally. The spheroidal tip is preferable in most instances because of its minimum tissue contact. Where, for esthetic reasons, the saddle-shaped tip is used, its contacting area must be reduced to a minimum not exceeding possibly more than 2 mm. Many of the present-day saddle tips are not fulfilling the requirements of sanitation, and prevent stimulation of the underlying tissues because of their size and poor adaptation to the ridge tissues.

The long pin facing shaped to conform with the requirements of tooth form and esthetics, with a tip of baked high-fusing porcelain and occlusal surface of gold affords the strongest and best means of restoration in most cases. The original glaze obtained by fusion of the high-fusing porcelain is much preferred to the glaze obtained by a porcelain overglaze or a low-fusing porcelain. These should be used only where, because of necessity, the form or size must be altered by regrinding after the gold portion has been completed.

The placing of tips in contact with ridges not completely healed, or in sockets of recently extracted teeth, is not in keeping with the modern trend of sanitation and the prevention of foci of infection. They should be placed only in slight contact with the tissue of ridges completely healed, with due regard to the kind, thickness and attachment of the mucosa, so that the underlying area will not be irritated or become hypertrophied.

In many instances, the patient seeks the

service of the dentist purely from an esthetic standpoint, without any regard for the restoration of lost function. This is not to be wondered at, for appearance plays a most important part in all of our lives, even to the extent that it may be the direct cause of the development of an inferiority complex or a psychic condition. Therefore, the operator must artistically reproduce tooth form, color harmony, facial contour and symmetry, that the final results may simulate natural conditions as nearly as possible.

With the average shade or color guide of about twenty-five shades, of which five or more are seldom used, and with a limited number of tooth forms, one can readily see how the operator is handicapped when he attempts to match a thousand or more combinations of tints and shades variously blended and an infinite number of shapes, sizes and irregularities of surfaces and abnormalities found in the natural teeth. By means of grinding, the facing can be altered to meet the specific requirements, or reduced sufficiently that the entire labial or buccal surface may be built up with high-fusing porcelain to the desired size, shape and color blending, incorporating such stains or developmental defects or irregularities as may be deemed necessary. Thus, the operator will be able to produce results which without this procedure would be impossible.

The placement of a bridge with shell crown abutments was generally a comparatively simple procedure, but the lack of accurate gingival adaptation was often in evidence as revealed by the roentgenogram or otherwise. Modern cast abutments require absolute precision during the assembling and soldering processes, so that they will go to place without undue torque and binding of the abutment teeth, and will fit accurately.

The bridge should be soldered in sections, at least one joint being left open for final soldering. Should the bridge not go to place properly when tried in the mouth, the operator should not hesitate to unsolder it, obtain the correct relationship and resolder in order to correct any discrepancies. Location, strength, size and shape of a solder joint are important. It should approximate the same form and occupy the same position as that of the natural teeth. The strength of the bridge will to a great extent depend on the physical properties of the solder used and the extent of change that has taken place owing to changed physical properties, the result of the solder being alloyed with the surface of the gold alloy. The soldering operation should be completed in the shortest possible time without excessive temperature, in order to prevent coarse crystalline formation, maximum strength being obtained and brittleness avoided thereby. Because of shrinkage, and since the solder is not of a strength equal to that of the high strength gold alloys used in the construction of the bridge, the solder joint should be as thin as it can possibly be made.

After the restoration has been completed, its efficiency and longevity may be materially increased by the cooperation of the patient, who should be instructed and impressed with the importance of mouth hygiene. The necessity of periodical examination, including a roentgenographic survey, must not be overlooked, that incipient pathologic conditions may be detected and the necessary occlusal adjustments made.

GENERAL ANESTHESIA*

By E. I. McKESSON, M.D., Toledo, Ohio

OF the general anesthetics which, in the past twenty years, have been employed for dental operations, nitrous oxide-oxygen, ethyl chloride, ether and ethylene have met the requirements under various conditions. Not only has the selection of one or another been influenced by the properties of the agent as to safety, but also so many other considerations have entered into the choice that confusion has arisen.

A dentist is wise to select ether when his patient must be cared for in a hospital where other anesthetics are rarely administered. Technical skill in the administration of any anesthetic is very important. The poorest of these anesthetics is probably safer in skilled hands than the best in the hands of the artless or inexperienced. Without some extraneous circumstance, quite independent of the merits or demerits of the anesthetic itself, ether is never the anesthetic of choice for dental operations.

If one's practice were limited to the extraction of deciduous teeth, including some permanent teeth in young, soft tissues of which quick removal was assured, ethyl chloride would be acceptable. It does not meet the demands for a safe anesthetic in other cases. Even in these easy cases, it is not the equal of nitrous oxide-oxygen for safety, low cost or general adaptability. Within narrow limits, it lends itself to a standardized technic, where a routine procedure is desired.

Conditions surrounding the operation often have a profound influence on not only the selection of the agent, but also the method of use. It is argued with some justice that local and block anesthesia give the immature operator more time for indecisive surgical work and permit the simultaneous instruction of many students working on different patients at the same time.

After graduation, these conditions change. Practice improves the operative technic, but private patients are treated after the manner learned in school, unless the graduate is uncommonly well financed and is progressive and unusually industrious. Sooner or later, he comes to rate anesthetics as they apply to his private practice. At a sacrifice of time, he may now acquire a knowledge of the technic, which he should have learned in school as a part of dentistry.

In many countries, dentists are not permitted to administer general anesthetics. The students of many dental schools in this country are not properly trained to do so, although general anesthesia, especially nitrous oxide-oxygen, is extensively used and occupies an important place in dental practice. While it does not lend itself to mass instruction, New York University, the University of Pittsburgh and a few other institutions have found individual instruction practicable.

A comparison of ethylene with nitrous oxide leaves much to be desired in ethyl-

*Read at the Seventy-Fifth Annual Session of the American Dental Association in conjunction with the Chicago Centennial Dental Congress, Aug. 11, 1933.

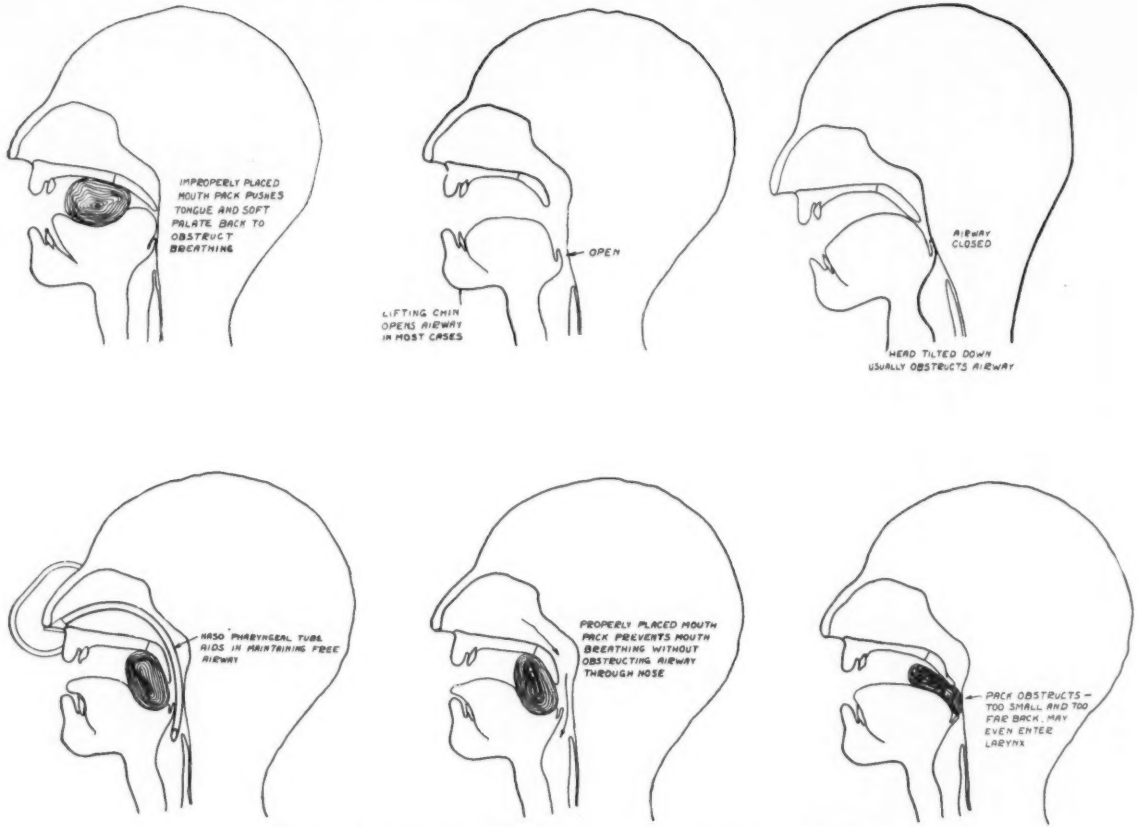
IMPROPERLY PLACED MOUTH PACK PUSHES TONGUE AND SOFT PALATE BACK TO OBSTRUCT BREATHING
OPEN
LIFTING CHIN OPENS AIRWAY IN MOST CASES
AIRWAY CLOSED
HEAD TILTED DOWN USUALLY OBSTRUCTS AIRWAY
NASO PHARYNGEAL TUBE AIDS IN MAINTAINING FREE AIRWAY
PROPERLY PLACED MOUTH PACK PREVENTS MOUTH BREATHING WITHOUT OBSTRUCTING AIRWAY THROUGH NOSE
PACK OBSTRUCTS – TOO SMALL AND TOO FAR BACK, MAY EVEN ENTER LARYNX

Fig. 1.—Causes and management or prevention of respiratory obstruction.

ene for dental operations. The odor of ethylene would bar it from most dental offices unless it were otherwise superior to nitrous oxide; but, in addition, it possesses the disadvantage of inflammability; which requires much care and watchfulness to exclude fire, cauteries and sparks from the operating room during its use.

Nausea and vomiting not infrequently occur during the light anesthesia under which dental operations may be performed. In this, ethylene resembles ether. After the operation, vomiting is more common. Ethylene reduces the volume of breathing; which is an advantage when an apparatus is employed with which adequate pressure is unobtainable for the use of nitrous oxide-oxygen. For this reason, a few obtain better anesthesia with ethylene than with nitrous oxide, although the comparison under such conditions is unequitable as regards the anesthetics. For the average dental case, as to time of induction or recovery, little difference exists between them. As to efficiency of anesthesia as between ethylene and nitrous oxide, the difference is negligible.

Nitrous oxide-oxygen is no longer limited to short operations, as it was several years ago. In fact, it has been shown repeatedly that it is the most suitable of the anesthetics for long operations. It is this property which has contributed largely to the success of the more thorough extraction operations, alveolectomy and plastic closure of soft tissues over apertures of recent years.

This anesthetic, unlike a local, does not interfere with the flow of blood into the sockets during operations. It does not produce ischemia as does a local, lowering tissue resistance, and there is a well-marked reduction in the time of healing, with much less postoperative pain and discomfort to the patient. It is this advantage of nitrous oxide-oxygen which has merited the preference of both the patient and the exodontist. Back of pain after a dental operation is often infection. It requires but a few seconds of exposure of bone and soft tissues without a normal blood supply to establish an infection in a wound. And while a bloodless field is a convenience during the operation, the patient often pays dearly for it in "dry sockets," pain or osteomyelitis. Most of the cases of osteomyelitis following the extraction of teeth may be traced to the ever-present mouth infection and local anesthesia with ischemia. Even in clean wounds outside the mouth and closed by sutures, local anesthesia is followed by more swelling and pain, with slower healing than that of tissues which have not been injected.

When the drug comes in contact with nerve trunks, certain sensory disturbances often follow, such as "hot-tongue" paresthesia, hyperesthesia or anesthesia of the nerve distribution lasting for variable periods. Paresthesia and neuralgia may be very persistent and the source of much discomfort for weeks or months. This effect is not peculiar to block anesthesia for extractions, but may affect other nerve trunks when they are injected. That local anesthetics are not the innocent drugs formerly supposed is sometimes tragically shown by paralysis of the lower extremities, and an occasional paralysis of oculomotor nerves, after spinal anesthesia.

While anesthesia or numbness and paresthesia may also be due to operative trauma, none of the common general anesthetics have such effects.

The limitations of an anesthetic sometimes stand in the way of proper treatment, as is illustrated by the impracticability of extracting four third molars at one time under block anesthesia; while general narcosis permits a complete operation, regardless of the number or

Fig. 1.—Causes and management or prevention of respiratory obstruction.

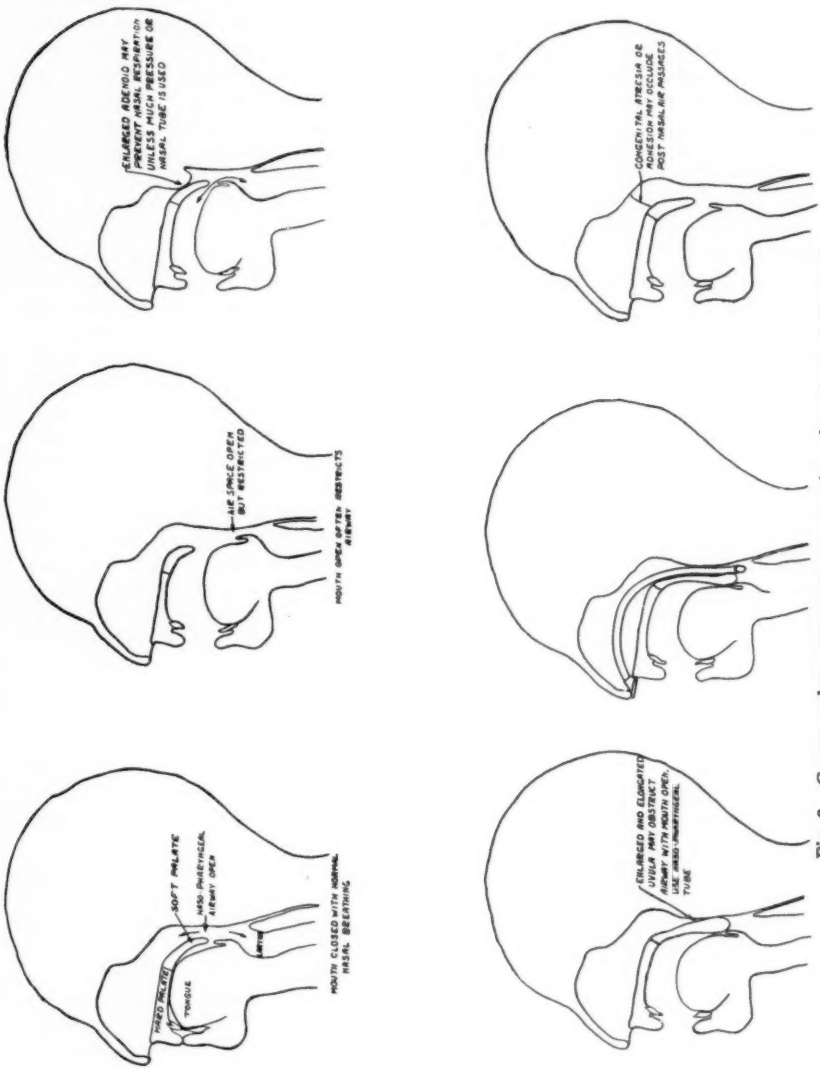
HARD PALATE
SOFT PALATE
NASO PHARYNGEAL AIRWAY OPEN
TONGUE
MOUTH CLOSED WITH NORMAL NASAL BREATHING
LIPS SINCE OPEN BUT RESTRICTED
MOUTH OPEN OFTEN RESTRICTS AIRWAY
ENLARGED ADENOID MAY PREVENT NASAL RESPIRATION UNLESS MUCH PRESSURE OR NASAL TUBE IS USED
ENLARGED AND ELONGATED UVULA MAY OBSTRUCT AIRWAY WITH MOUTH OPEN. USE NASO-PHARYNGEAL TUBE
CONGENITAL ATRESIA OR ADHESION MAY OCCLUDE POST NASAL AIR PASSAGES

Fig. 2.—Causes and management or prevention of respiratory obstruction.

distribution of the teeth to be removed.

Patients dread any operation, and sometimes either postpone it indefinitely, or try another dentist after the first operation, when extraction is done in stages. Other considerations than the anesthetic should determine what and how many teeth should be removed at once, so that the patient's best interest may be served. The induction of nitrous oxide-oxygen is at least no more unpleasant than the introduction of local or block anesthesia, but when the patient is asleep, no further fear, delays, arguments or interference on his part hampers the operation, which may be done in less time and more thoroughly.

An unconscious patient does not criticize or magnify the operative manipulations to her friends, but the conscious patient may later do much damage to the dentist or to dentistry in general by uninformed descriptions of the technic used or the remarks made.

Dental operations, for the most part, are performed on ambulatory and therefore "good risk" patients. And while some cases require anesthetization for an hour or more, the great majority of operations are completed within a few minutes. The greatest danger in a general anesthetic is asphyxiation; which applies to dental no less than to other operations. As the dental patient is less frequently bedridden, asphyxia during operation constitutes by far the most important risk —a risk which is easily avoided with proper care and attention to technic.

Asphyxia is a broad term, including any grade of respiratory inadequacy from any cause with a resultant inadequate supply of oxygen with or without accumulation of an excess of carbon dioxide or other products of metabolism. Anoxemia is a more specific term relating to an inadequate supply of oxygen only.

Every general anesthetic requires (1) the maintenance of an open airway through which the patient may breathe without interference and (2) anesthesia light enough not to interfere with or restrict the act of breathing. These two are the basic principles upon which successful and safe anesthesia rests in every case. The whole technic of good anesthesia in one way or another finally comes to be dependent on freedom of the respiratory passages and a level of anesthesia short of respiratory depression.

Relatively slight interference with the air passages by depressing the mandible, by backward movement of the tongue, by pushing mouthpacks in too far, or by entrance of blood or clots into the pharynx may, and usually does, diminish the exchange of gases in the lungs sufficiently to cause asphyxia of varying degrees. One may determine this condition very easily by noticing the extra effort of the patient on inspiration or the "sucking-in" of the skin above the clavicles and the lower end of the sternum, since the obstruction is most noticeable on inspiration.

Now if respiration is inadequate at the beginning of narcosis, that is, after anesthesia has been under way for only a minute or two, the obstruction interferes with the supply of anesthetic gas to the lungs and the patient tends to recover from the anesthetic, since the tissues abstract the gas from the blood; which thus decreases its tension in the circulation. Asphyxia is not the result of partial obstruction to respiration in such conditions; but, with lightened narcosis, the patient usually frees the airway himself. On the other hand, if the patient has been under the influence of the anesthetic for several minutes, restriction of the airway causes asphyxia of some degree, as is shown by labored breathing, muscular twitching or rigidity, dilation of the pupils and those signs also indicative of

Fig. 2.—Causes and management or prevention of respiratory obstruction.

profound anesthesia, since the oxygen in the mixture administered fails to reach the blood in adequate volume to satisfy the patient's requirements or utilization of this gas. The nitrous oxide or other anesthetizing vapor or gas is unable to escape into the tissues, which have already been partially saturated in the early minutes of narcosis.

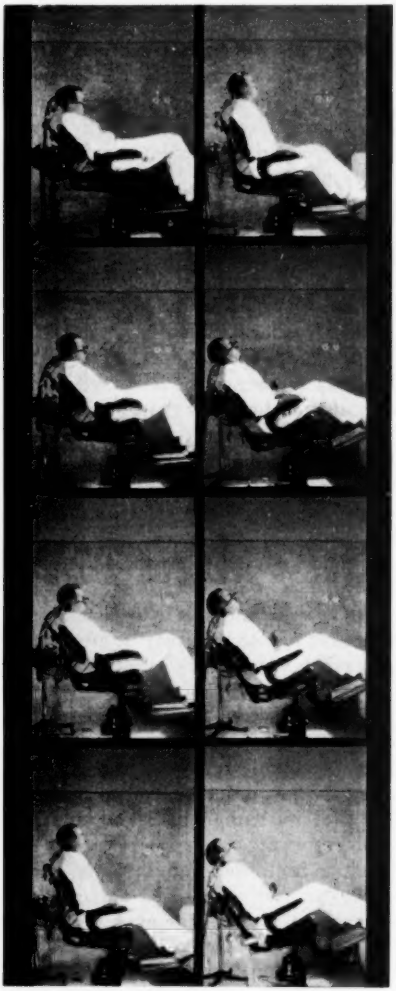

Fig. 3.—Positions in chair. A level seat usually permits the patient to slide forward and the airway is obstructed during anesthesia. Tilting the seat backward materially favors a good position and free airway.

Freeing the air passages alone may be sufficient to restore the patient to a normal state of anesthesia within a few breaths, but it is often necessary to increase the percentage of oxygen admitted to the lungs for a breath or two to restore more quickly the normal plane of narcosis.

An excessive dose or concentration of anesthetic vapor or gas with an inadequate percentage of oxygen soon reduces the volume of breathing. Anoxemia may thus be produced, even with a "clear" airway; while asphyxia usually results from partial obstruction of the air passages.

Now the difference between asphyxia and anoxemia is usually of academic interest rather than of practical importance, since, by an increase in the percentage of oxygen, if prompt, the normal plane of anesthesia and adequate breathing in either case is restored. An increase in amount of oxygen or pure oxygen for a breath or two slows or momentarily stops breathing, if simple anoxemia was present; while in asphyxia, that is, oxygen-want plus an excess of carbon dioxide, such increase prevents the respiratory pause after the breath or two of oxygen has been inhaled.

When anoxemia or asphyxia is carried to apnea, that is, the point where the patient no longer makes an effort to breathe, respiration is readily restored by filling the lungs half full of oxygen two or three times with the apparatus, provided, of course, this is done at once. No time should be lost in putting oxygen into the lungs. Every second of delay increases the danger to the patient. Yet

if it is promptly done, no damage results.

Partial asphyxia from very profound anesthesia continued for a long time or considerable obstruction to the air passages for a relatively long period may, in susceptible individuals, lead to symptoms of asphyxia rarely seen after anesthesia. On the withdrawal of the anesthetic or with the administration of air or oxygen, such a patient breathes deeply—sometimes snores loudly—fails to recover consciousness in the usual time (from two to five minutes after nitrous oxide anesthesia), talks or mumbles incoherently and is slow about walking. When consciousness returns, it may be confused for minutes or hours with loss of memory. Such symptoms are common when asphyxia has followed inhalation of illuminating gas, coal gas or other fumes over considerable periods and in which degeneration of the lenticular nucleus have been found at necropsy.

In reciting the dangers of marked asphyxia from overdosing or that intensified by obstructed breathing, it is the purpose to emphasize as much as possible the importance of preventing their occurrence, which forms the basis and to a large extent determines the details of technic for general anesthesia. These details differ with the kind of operation and the condition of the patient. Details for chest surgery are not those of abdominal operations or dental cases.

The man is well paid who masters a technic in anything—no less in anesthesia than in any other procedure.

A practical technic should not be encumbered with fads, styles or fancies, but should be stripped to the rational scientific procedure followed for a good reason and in a manner to secure the desired results.

PROCEDURES TO PROVIDE OPEN AIR PASSAGES TO THE LUNGS

Position of the Chair.—Whether the chair holds the patient vertical or tilted back slightly or markedly is immaterial. It is important that he be unable to slump or slide down in the chair after anesthesia is induced. The seat (preferably a carved one) is tilted backward far enough to make it almost impossible for the patient to slide forward. The weight of the body then keeps the buttocks in the angle of the seat and the back rest. The back rest is then adjusted forward or back as preferred for the operation and shifted up or down until its upper edge is from 2 to 4 inches below the level of the shoulders; which provides space for proper adjustment of the head rest.

The headrest pads are placed back of and under the occiput and mastoid eminences, so that with the mouth open, the head and neck are in line with the chest. If the patient is "round shouldered," the headrest must be correspondingly forward of the standard position to secure a free airway. The headrest should be firmly locked in position. When the buttocks cannot move forward on the seat, the head will not be thrown forward to choke the patient. If the headrest is placed as described, the head does not fall forward with relaxation of the neck muscles during anesthesia, but tends to keep the neck lifted, especially when pressure is applied on the forehead or the mandible is supported by the operator's hand or the hand of the anesthetist. Readjustment of the headrest may be required during anesthesia to secure maximum freedom of the air passages under relaxation.

The illustrations show common errors of position and their effect on the airway.

The hands are clasped together, interlacing the fingers. Straps are rarely needed, but, if used, should be applied after the patient is unconscious, passing over the hands or forearms and across the pelvis and buckled or tied behind the

chair. A strap should not cross the chest or the upper abdomen, since it restricts breathing and is not necessary. Almost any movement of the body in the chair from the position just described tends to embarrass breathing and to interfere with anesthesia.

Mouth Prop.—Many kinds of mouth props are available. Some are better than others. One should be selected which is not easily dislodged by the manipulations of the operator or by the patient, and which does not cramp the field. The Depass is not perfect, but approaches the ideal better than most props. Above all, the prop should not open the mouth so far that the airway is restricted by forcing of the soft parts of the floor of the mouth backward. Airways of patients with short mandibles are more easily obstructed in this way. The prop is placed after the patient has inhaled a breath or two of gas, but before loss of consciousness prevents voluntary cooperation. Some prefer to insert the prop just before or simultaneously with starting the administration to make sure that the patient can breathe freely with it in place.

Pressure of Gas as an Aid to Breathing.—Many nostrils are too small for easy respiration or the alae may draw in during inspiration. Normally, they should open.

When the nasal inhaler is applied airtight over the nose, there should be enough gas pressure to promote easy inspiration, especially while the patient is conscious and fears he may not be able to inhale. Four or five millimeters of mercury pressure is ordinarily sufficient unless there is considerable restriction in the nares, due to the presence of spurs, deviated septums, polyps or adenoids, when more pressure is desired.

After anesthesia has been induced, more pressure is usually required to prevent the ingress of air through the mouth and to keep the soft tissues about the pharynx ballooned or slightly distended, making space for breathing, and also to keep the mouth pack away from the posterior pharyngeal wall. Sometimes, as much as 20 mm. or more is required for this purpose, but usually from 10 to 12 is sufficient. The insertion of a suitably constructed soft rubber nasopharyngeal tube with a nose flange is sometimes a marked aid to maintaining the airway when the mucous membranes are thickened or engorged enough to restrict the nasal passages. But it should not be passed through the nose until after anesthesia is secured and should be well lubricated with K-Y jelly. Such a tube or tubes also help to keep the base of the tongue forward.

Mouth Pack.—The mouth pack should serve three purposes: (1) prevent foreign bodies from entering the larynx; (2) prevent the inspiration of air, and (3) restrict the escape of gas and thus aid gas pressure in ballooning the soft parts at the epiglottis. Unless properly designed and placed, the pack may obstruct breathing instead of aiding it. For this reason, the pack should be large, the tongue pulled forward with the tips of two fingers and the pack pushed slightly beyond the curve at the base of the tongue, space being left between it and the posterior pharyngeal wall. It is placed after anesthesia is established. A folded kite shaped pack is usually effective.

EFFECTS OF ANESTHESIA

Much has already been said regarding the technic and means of maintaining the patency of the air passages leading to the lungs. The muscular action of the chest and diaphragm effecting breathing is of equal importance, but this is influenced by the anesthetic itself. The muscular act of respiration outranks all other signs

of anesthesia. It may be stated that breathing is increased in rate during induction and light anesthesia; becomes more normal in normal anesthesia, and is increased in volume in deeper narcosis. In very deep anesthesia, the rate is slower and the volume diminished, so that, as the patient approaches anoxemia, the respiration becomes less efficient, with less exchange of gases in the lungs owing to central effects of the anesthetic.

The rate of respiration and the quantity of gas taken per breath may be measured during narcosis; but, in routine practice, this is not ordinarily done in dental anesthesia, since the sound of exhaled gas escaping and the movements of the chest give reliable estimates of the efficiency of respiration. A very simple test is also available, if in doubt. For this purpose, if respirations have become less effective, one may give a breath of gas containing a high percentage of oxygen, after which the respiratory movements are noted for a few breaths. If improvement results, the percentage of oxygen is slightly increased in the anesthetic mixture, provided, of course, other muscular signs, such as those of the arms, legs, eye and facial muscles, do not show that the patient is approaching recovery from the anesthetic. These signs have been described in detail in several previous papers. The point to be stressed here is that anesthesia should be controlled so that breathing is adequate and not impeded by overdosing with the anesthetic.

CARBON DIOXIDE

From observation, it may be claimed that patients rarely if ever exhale an excess of carbon dioxide in dental operations. The operation itself practically precludes such excessive or free breathing. It is a fact that administration of carbon dioxide slightly in excess of normal, which may be assured by careful administration of this gas along with nitrous oxide-oxygen and more easily obtained by the rebreathing of a little more than half of each breath, produces a more persistently increased depth of breathing than otherwise, and with better anesthesia as a result. With rebreathing, this is possible. In dental cases, there is no danger of accumulating too much carbon dioxide, but there is danger of giving too much carbon dioxide when it is delivered from a tank of this gas.

Administration of carbon dioxide tends to mask the respiratory signs of oxygen-want by stimulating respiration when the patient needs more oxygen. This is particularly true when this gas is not accumulated by rebreathing but delivered from a tank.

Carbon dioxide does not take the place of oxygen in any sense, but rather augments the anesthetic effects of nitrous oxide. It possesses some anesthetic properties in concentrations of more than 10 per cent. For this reason, a patient deeply anesthetized should be given oxygen, not carbon dioxide. And while administration of carbon dioxide under 20 per cent concentrations stimulates respiration, it often fails to do so in deep anesthesia or in the absence of enough oxygen to lighten the narcosis.

Overdosing a patient with nitrous oxide is quickly, almost instantly corrected or prevented, if pure oxygen is forced into the lungs. It should not be administered without an apparatus constructed to inflate the lungs with oxygen when required. This method of resuscitation is by far the quickest and safest.

The use of carbon dioxide as an irritant or respiratory stimulant is uncertain when it is needed most and does not take the place of insufflation of the lungs with oxygen as in resuscitation. It is a refinement in anesthesia of some value, but much overrated by some enthusiasts and

not without danger when concentrations of more than 5 per cent are employed.

Nitrous oxide-oxygen is an inherently safe anesthetic because it is relatively difficult to produce dangerously deep narcosis with it without pronounced symptoms of asphyxia. It requires skill to secure deep muscular relaxation with it. Its record for safety in dental operations may be due in part to the fact that deep relaxation is not required. Anesthesia with immobility only is needed, and this is possible without much effort.

THE RESISTANT PATIENT

So much has been written for the average normal patient that a few words regarding the resistant muscular or alcoholic types may be of more value. More time is required to produce anesthesia in these cases. Time, in fact, is next in importance to the proportion of nitrous oxide-oxygen in the mixture employed. If care is exercised to administer the least oxygen that will keep the patient breathing effectively and permitting the patient enough time, satisfactory anesthesia may always be obtained in these cases.

Owing to the character of breathing, it is usually necessary to administer the gases at from 15 to 30 mm. pressure to keep the air out. Exclusion of air is always necessary in any case, but is obligatory in these cases, and must be practiced from the beginning of induction. After anesthesia is established, the oxygen may be increased 1 or 2 per cent during the operation, but must always be watched more closely than usual for evidences of recovery. These patients respond quickly to oxygen administration and out of proportion to the increase in percentage.

CONCLUSIONS

1. Nitrous oxide-oxygen is the anesthetic of choice for dental operations.
2. The technic of administration should be directed against any interference with respiration, either mechanical or central in origin.
3. Mechanical interference is best prevented by suitable position, the use of well-placed mouth packs and administration of gas under various pressures (usually 10 to 15 mm. Hg.).
4. Central depression of respiration is prevented by the use of proper mixtures of gas and oxygen or is corrected by insufflation of oxygen into the lungs under intermittent pressure to simulate breathing.
5. General anesthesia favors thorough surgical work without interruption, and minimizes postoperative pain and infection as compared with local anesthesia.

THE COUNCIL ON DENTAL THERAPEUTICS*

By U. GARFIELD RICKERT, M.S., D.D.S., Ann Arbor, Mich.

IT must be evident to any careful observer that it is springtime in dental reforms. Housecleaning is in full swing. Parasitic proprietary régimes are being swept through the back door. After the investigation of the Carnegie Foundation, practically all proprietary dental schools either disappeared or took cover under the protecting wing of accredited universities. The American Dental Association, through its Council on Therapeutics, is now engaged in dusting un-

*Read at the Seventy-Fifth Annual Session of the American Dental Association in conjunction with the Chicago Centennial Dental Congress, Aug. 11, 1933.

scientific proprietary medicines from its materia medica and, finally, there are already those with brooms in hand determined to sweep out and fumigate the undesirable aspects of proprietary journalism.

Like the annual cleaning in which the housewife assumes leadership, the inescapable task is not a pleasant one, and everyone welcomes the time when the ordeal will be completed. We always have among us, though perhaps necessarily so, some well-meaning idealists who, in their zeal for complete renovation, would break and burn the furniture and start all over again. I am not one of these. Experience has taught us that the most practical way to improve a city is to begin with the worst of the slums and to carry on until the task is completed. Wise leadership in dentistry will insist on reconstruction evolving in much the same way, along well-planned lines.

This paper is presented to you with the purpose of stating as clearly as possible just what the remodeling plans of the Council on Dental Therapeutics are, and what progress has been made in the brief experience of the Council. The very nature of the work is controversial. The members of the Council realized from the beginning that, until it had fully established itself, and a majority of the dental profession were familiar with its aims and objects, it would have to travel a rather stormy sea. Fortunately, with the exception of a few attacks by the uninformed, the Council has had the wholehearted support of the entire profession.

A quarter of a century before dentistry began its investigations, the American Medical Association, recognizing the exploitation of both the public and the medical profession by nostrum racketeers, established its Council on Pharmacy and Chemistry. For a number of years, it too had a stormy course to pursue. There were members of the profession who, either directly or indirectly, profited from the sale of proprietary medicines. Others had friends among the exploiters and feebly protested interference with their activities. The journals were carrying advertisements of questionable products for what then seemed to be necessary financial reasons.

With such influences arrayed against honesty in general medicine, needed reform seemed at times to be almost hopeless. However, with the intelligent and forceful editorial policy of the *Journal of the American Medical Association,* with the influence of the federal government in the enactment of more stringent laws in regard to drugs, with the wise leadership in medical education and in organization and, finally, with the outstanding efforts of Dr. Wiley, the stubborn resistance encountered from those profiteering in pseudoscientific medicines gradually decreased. A censored advertising policy on the part of a large number of the medical journals dealt the final blow.

Easy money, which is so readily obtainable from those who are sick or think they are, prompted these same profiteers to cast about for new fields of exploitation. They found virgin soil in the field of the less vigilant dental profession. It is interesting to observe how many exploiters, originally driven out either through the efforts of the Council on Pharmacy and Chemistry or the food and drug investigations, now are dispensing dental proprietaries, in many instances equally questionable.

Many of these preparations are sold directly to the public. They are advertised over the radio and in the popular journals. What is of even more significance to the profession is that many of its members have themselves become inno-

cent accomplices and are advertising these products by passing out to their patients beautifully wrapped proprietary remedies with carefully printed instructions for their use. Frequently, the dentist has no more information concerning the contents than the printed statement on the package. One dispenser of medical nostrums boasted that as soon as a certain percentage of practitioners were induced to pass out samples of his product, it at once established for him a million dollar business. Unfortunately, too, during the depression, many dentists, observing the seeming fortunes made in the sale of dental cosmetics, attempted to get into the business before it was too late. Few of them realized the cost of marketing their product in an already overadvertised field. It would appear that, in order to succeed financially in the business of marketing a tooth paste, the dentist would be compelled to abandon much of his professional ethics.

Our materia medica, like Topsy, "just growed." There was no systematic or cooperative study, nor any authoritative body to pass on the merits of our materia medica and therapeutics. The individual practitioner selected, by trial and error, those drugs which seemed most nearly to meet his needs. Even the schools were working independently. There was no part of the organization devoted to the teaching methods of this subject until about three years ago, when a section on materia medica and therapeutics was established in the American Association of Dental Schools. This aimed to improve the teaching of the subject and develop a closer cooperation with the work of the Council on Dental Therapeutics. It developed from the programs of this annual sectional meeting that we had accumulated a materia medica lagging in scientific achievement far behind the more mechanical aspects of dental practice.

Publishers recognized the hopeless irrationality of our therapeutics. Many teachers were requested to write textbooks on the topic, but few of them had the courage to undertake such a task in view of the existing unscientific status of the subject. Nearly everyone realized that, with the increased interest and the rapid progress that was being made, and the fact that the Council on Therapeutics would soon publish an authoritative report (Accepted Dental Remedies), any text that could be written at that time would be out of date before it came from the press. Now that our Accepted Dental Remedies is being published through the columns of THE JOURNAL and, at the completion of the series, will be available in book form, we believe that one or more authoritative texts will soon be available, both for teaching purposes and for the use that may be made of them by the general practitioners. Accepted Dental Remedies will not be a text on dental therapeutics, but will be a reference work tabulating drugs in good standing, which should make the writing of a text on materia medica and therapeutics an easier task.

Perhaps the workings of the Council can best be presented through the quotation of certain questions that members of this body are frequently asked, together with their answers.

1. *Who determines what products are to be investigated?*

(a) Since the number of dental proprietaries is increasing so rapidly, the amount of work necessary is stupendous, and a considerable amount of time is needed in order to cover the study adequately. So far, many of the requests for investigation have come from the dentists themselves. When a number of dentists inquire about a product in which they are interested, the preparation is examined.

(b) At other times, the product is submitted for examination by the manufacturer himself. In fact, a large number of products which have been accepted have been selected and submitted by producers having sufficient faith in their preparations to welcome investigation.

(c) By another common method of selection, members of the Council assume the responsibility. If a member of the Council believes that a product is grossly misrepresented in its advertising, he may request the secretary to begin investigation through the regular channels.

2. *Who writes the reports?*

The referee appointed from the Council, after the various committees have submitted their reports to the Council, edits these reports. To illustrate: There is a committee on pharmacology and therapeutics composed of specialists in the field and, similarly, in other of the related sciences, committees are appointed to direct their phase of the work. When they have handed in their reports with the necessary information, a referee is appointed who, with this information as a basis, writes the report. It is then published through the biweekly bulletin of the Council, where it is studied and checked by each member. In a later issue, a vote is taken, approving or disapproving the referee's report. It is a rule of the Council that no less than seven of the ten members must support the report before it is approved. It is interesting to note that, as far as I can recall, no product has yet been denied acceptance without unanimous disapproval.

3. *Why are products prepared by large companies more frequently accepted than those of smaller concerns?*

I do not know that this is a valid question, for I am not at all sure that products prepared by large companies are more frequently accepted than those prepared by smaller concerns, for many acceptances have been given to the smaller sponsors. If it is true, it is perhaps due to the fact that large pharmaceutic houses have learned from experience that no concern which depends on exploitation for its income can prosper for very long. It is perhaps also true that their business sense would not permit them to depend on misstatements in advertising for the sale of their products. The oldest high-type manufacturers and pharmaceutic supply houses are most conservative in their advertising, especially to the public. In many instances, they carry on rather creditable research. They inform themselves before going on the market with their products. The exploiters, on the contrary, talk research, but their investigations are largely devoted to the reading of the literature and using unproved theories as truths. They then apply remedies which, if the theory were known to be true in the first place, might be of some value. A good example of the application of an unproved theory is the attempt to eradicate the dental film or plaque. Frequently, the alleged research worker is without scientific or professional training.

Another reason that the large manufacturer might seem to be more successful in having his products accepted is that he has many more to submit than the small manufacturer.

4. *Why does it take so long from the time a product is submitted for examination until it is finally passed upon?*

From the brief description that I have given of the workings of the Council, it will be seen that the investigations of each product by special committees, the report in the bulletin and the comments of the members on the report, which may necessitate that the original report be rewritten—all take a great deal of time. It must also be remembered that the men who do this work for the Council must earn their living in some other way and

cannot always attend to the work as soon as they would like to. This condition will probably continue until the A.D.A. can provide assistants who will make more chemical analyses, bacteriologic tests, etc.

5. *Why is so much time devoted to the investigation of tooth pastes instead of to the more important dental materia medica?*

This constitutes a misstatement of fact. The Council does not devote more time to the study of tooth pastes than to dental medicines. Owing to the somewhat spectacular nature of the tooth paste problem, these reports have attracted more attention than others which have been more numerous but not so spectacular. The dentists themselves first asked the Council to investigate certain tooth pastes, which the Council did investigate and report on.

From the preponderance of requests from members of the profession concerning tooth pastes, it is evident that many persons have misunderstood the main purpose of the Council. It was authorized with the idea of improving and simplifying the entire field of dental materia medica. The Council never held the subject of dental cosmetics to be of major importance.

It might be well to further clarify this issue relative to dental cosmetics. There are those who have wondered why no report has been made on a specific mouth wash. The Council has never recognized that any stock preparation sold to the public had any therapeutic value. Varying conditions of oral disease require that the dentist write his own prescription, one suitable for the specific case in question. Since so few requests have been referred to the Council for prescriptions of this nature, this aspect of the work has not been very prominent. With the tooth paste question, we have a somewhat different situation. The Council recognizes the importance of oral hygiene. It recognizes, too, that it is possible to prepare a dentifrice to aid in more complete oral hygiene. Because of this fact and the demand from the profession, the tooth paste issue could not be avoided.

Another reason that tooth pastes have received attention from the Council is that some of them may be positively injurious. Some have contained toxic substances. Some, which are devised to bleach the teeth, have contained acids which are injurious. Some contained grit, with which much harm might be done if used over a period of time. The classification of these dentifrices into injurious and noninjurious became a duty of the Council.

The Council also recognizes that it should cooperate with manufacturers of dental cosmetics and should point out to them the harmful ingredients, if there are any, before acceptance or rejection takes place. The Council is endeavoring to protect the public against misleading claims in regard to dentifrices. In passing, let me say that one outstanding offender in this direction who most confuses pseudoscience with science and research in advertising has never had enough confidence in his product to submit it to a qualified authority for approval. He has preferred to go on with gross misrepresentation and no handicap in advertising. There is at the present time a reaction on the part of not only the dental profession but also the public against this case of exploitation, by which the privilege of radio and popular journal advertising has been so abused and attempts have been made to anesthetize the profession into acquiescence by the subtle salve—"see your dentist twice a year." It will be a sorry day for dentistry if the public ever comes to believe that the profession is in league with this exploitation.

7. Why have you not published in concise form a complete report of the products investigated and acceptable dental medicines?

The reason is an economic one. This work has been delayed because the A.D.A. has not had the funds to finance such a publication. A year ago, such a report was ready, but there was no money to publish it. At the present time, the Editor of THE JOURNAL has agreed to publish Accepted Dental Remedies serially in THE JOURNAL. When this report is completed, we will once more endeavor to publish the entire list in a book form somewhat similar to that of New and Nonofficial Remedies of the American Medical Association. This work will be available to all members of the profession who wish to improve their materia medica and therapeutics. It will not necessarily be interesting reading material, unless one enjoys such reading as the standard English dictionary.

One of the difficult problems that has been met in the functioning of the Council is that of trying to be consistent with the newer ideals and practical in their application, in view of traditional and customary practices with certain of the proprietary régimes. To illustrate: Dental journalism for many years depended on advertising for its financial support. In order to have financial support, it had to close one eye, or at least wink, at certain questionable products grossly misrepresented, because it was believed that some good was coming from these channels to justify the evils. In other words, we practiced the theory that indirect taxation is less painful than direct taxation. Every intelligent member of the profession knew that he was paying in some way or other.

The advertising managers of some of the journals still believe it impossible to cooperate with the Council in the sale of their advertising space. Some of the journals which are complying have complained that their advertising is falling off. There are several factors to be considered in this. First, there has been a general decline in all kinds of advertising owing to economic conditions. Secondly, there is a general reaction against advertising of many commodities because of abuses in advertising in the past. Copywriters everywhere recognize this fact. Many worth while commodities are not nearly so extensively advertised today as they were five years ago.

Another point to be taken into consideration in this regard is the experience of other professional journals. They have found that when they refused to accept for advertising products which they knew to be worthless, they were able to demand a much higher price for the advertising space which they did sell. We are in no way objecting to intelligent, truthful advertising. We believe it has value, but we do object to gross misrepresentation, whether of an instrument or of a nostrum. We anticipate that until business managers view these facts with alarm and set themselves to correct the evil, both the Council and the journals will be confronted with difficulties. We would even welcome another standing committee to investigate products referred to the journals for advertising which do not fall within the purview of the Council. We might then have an authority by which an advertising manager could determine whether to accept advertising matter on a product, as it is now possible to do with drugs, etc., with which the Council is dealing.

Let us assume that there has been a loss in advertising to our journal of $15,000 —to take an arbitrary figure—as a result of the work of the Council. Now let us turn to the other side of the ledger and cite typical cases of the kind of advertis-

ing which should have been lost in this way. One of the preparations was a pyorrhea cure. It was found on examination to be approximately 40 per cent solution of sulphuric acid. Twenty cubic centimeters of this product—less than 1 ounce—sold for $10. Now if the dentist wished to use a 40 per cent solution of sulphuric acid in the treatment of pyorrhea, he might obtain the materials in this preparation for a few cents, if he knew what it contained; which in this case he did not, because the formula was not made public. If 5,000 dentists had had this information and made use of it, they might have saved $50,000.

Another illustration is that of a topical anesthetic. The materials in this cost 10 cents and the product was sold for $2. If 10,000 dentists had made use of the information made available by the report of the Council on this product, they might have saved $19,000. Another preparation which sold for $1 was found upon examination to contain ingredients which cost about 1 cent. Since this was originally sponsored by a well-known member of the profession, we can assume that it had a rather large sale. These illustrations give concrete evidence as to how the work of the Council can save the profession many thousands of dollars more than the loss sustained in the advertising of worthless products.

Manufacturers have sometimes pointed out that when the dentist considers the number of cases that he can treat with a $2 bottle, the cost per patient will only be a few cents. Unfortunately, the manufacturers of every other product used in a dental office justify their prices on the same grounds. Nowadays, when every economy is important, these seemingly small things must be watched; for it is the few cents of overhead here and there in a practice which bring about economic difficulties for the dentist.

The Council aims to aid the dental profession in three ways:

1. By making available unbiased information concerning various dental remedies.

2. By encouraging more rational use of drugs in dentistry.

3. By furthering cooperation with manufacturers of worthy dental products.

This requires that we engage in both constructive and destructive criticism. The most encouraging aspect of it all is that the howling of a few lone wolves has so far failed to submerge the plaudits of an appreciative profession.

The Council is destructive in that it rejects worthless proprietaries. It is constructive in that it accepts worthy proprietaries. It is destructive in that it opposes selling of irrational, complex mixtures, making of exaggerated therapeutic claims and the use of meaningless therapeutically suggestive names. It is constructive in that it evaluates established drugs and recommends drugs of proven worth and correctly descriptive names. It is constructive in that it will supply this information to the dentists as far as it is known, and it admits its limitations when there is no available information. To illustrate this point: Recently, there have been many requests for a topical anesthetic with the special purpose of making the prick of the needle of the hypodermic syringe painless. We knew of no satisfactory drug for this purpose, but, because of the general interest, we at once began investigation of the subject with the cooperation of trained investigators not members of the Council. We found that most of the advertised preparations, which sold at many times their actual cost, were not acceptable to the investigators.

Recently, an article has appeared in one journal and a critical editorial in another concerning the Council. It was

evident from certain of the statements made in both of these articles that neither writer knew the facts relative to the working of the Council. One of the authors admitted that the Council had refused seven of his products. The other was formerly interested in a product which was found to be nonacceptable by the Council. One wonders how much of these criticisms was inspired by the fact of nonacceptance of their products. Some of the most ardent objectors to the work of the Council have also got into difficulties with the Food and Drug Department of the United States Government.

We wish to make it clear that the Council is a respecter of no one sponsoring questionable, unoriginal, deceptive, misnamed preparations devised only for the benefit of the producer and the salesman. In fact, the Council would have been franker in its condemnation of this type of product if it had not been for a few powers in the profession who, while admitting that we were right, insisted that we were going too fast.

The members of the Council realize fully that, many times, those interested in progressive movements become so blinded with the importance of their own activity that they believe it to be the only worth while project in the organization. Not so with the Council. We know that there are many undertakings of great importance to the profession. We are in no way attempting to prove that the rationalization of our materia medica, the financial saving for the profession and the public and the exposure of advertising evils should be continued at the expense of other departments. We have stated our case clearly and are willing to rest the question of its importance with the dental profession, which is becoming more and more aware that if we are to maintain our self respect and the respect of the public, it becomes highly important that we lead in the fight against racketeers who insinuate in their advertising that the members of the dental profession come to them for scientific advice and information, and that the profession is in league with or at least approve of their methods.

The future security of the Council depends largely on the support that it receives from the members of the profession at large. It must be remembered that the security of the Council and the security of the individual members of the Council are quite independent of each other, as the members receive no payment for their services. We are not terrorized by a fear of losing a breadwinning position. We are, therefore, willing to leave the entire question of the worth-whileness of this program to the members of the dental profession.

CONTROLLING FACTORS IN THE MANIPULATION OF GOLD FOIL*

By LEROY L. HARTMAN, D.D.S., New York City

ANY method of treatment of dental caries which has stood the test of time deserves our most earnest consideration. In what other field of the healing art are there definite records of successful treatment lasting over a period of forty, fifty and even eighty years?

Between the years 1850 and 1852, Dr. Parmelee, of New York City, inserted some noncohesive gold foil fillings for Dr. Stevens, a physician now approaching the century mark. Many of the fillings were in pits and fissures, and they are just as good today as they were when they were inserted. Records are extremely common of gold-foil fillings lasting over a period of forty or fifty years. Practically every dentist in practice has such records among his own patients. This group of fillings consists of noncohesive foil as well as cohesive foil or combinations of the two.

The early practitioners were more interested in filling cavities than in restoring contours and, for that reason, many teeth were lost from periodontal disease rather than from the recurrence of caries. Every operator of today has observed other reasons for the failure of gold foil restorations, such as the presence of checked, crushed or discolored enamel margins or fillings loosened while being inserted or as a result of stress of mastication. The surfaces of some fillings are found pitted or flake when being polished, while other fillings crumble or spread under stress and in that way lose their original contours.

Many volumes have been written describing various methods for the successful manipulation of gold foil as a filling material. Thousands of clinicians have added their contribution to a more thorough knowledge of the working qualities of this material. Theories and technics were to be found on all sides when G. V. Black presented the results of his classical observations and experiments. His work in cavity preparation and gold foil manipulation established definite ideals and presented methods for their accomplishment. Any deviations from the principles of cavity preparation as presented by him have usually led to difficulties for the operators.

It is my object to confine my observations as nearly as possible to the physical processes involved in the introduction of gold foil into tooth structure, so as to insure the successful starting, filling and finishing of gold foil fillings which will stand up over a long period of time. Three groups of experiments will be reported.

In the first group, experiments with various methods of gold foil manipulation show that, by some of the technics long discarded, harder fillings can be obtained than any reported in Bulletin 32 of the Bureau of Standards. Some simple methods result in virtually uniform results,

*Read at the Seventy-Fifth Annual Session of the American Dental Association in conjunction with the Chicago Centennial Dental Congress, Aug. 10, 1933.

while others still used by practitioners produce fillings with a Brinnell hardness less than that for cast 24-carat gold.

In the second group of experiments, cavities were prepared in extracted teeth with cutting and finishing instruments advocated by different operators of today, particular attention being paid to the formation of convenience and retention points in the dentin and to the planning and finishing of the enamel walls. These teeth were then sectioned through different planes to expose the shape of the point angles in the dentin and the finish of the enamel walls.

In the third group of experiments, cavities of the same type as those prepared by the second group of experiments were prepared in extracted teeth and those cavities filled with cohesive gold foil, the idea being to show the efficiency of methods in practice for contour restoration, several different technics being used and the fillings finished and examined to detect any checking or crushing of the enamel wall as well as the adaptation to the margins. The teeth were then broken away from the fillings and the fillings examined under a microscope. The contour portions of the fillings were then checked for Brinell hardness. The observations are herewith presented.

Group 1.—Two blocks of "ivorine" were bolted together and, in the center of these blocks, a cavity was tooled 3 by 3 mm. deep, so that one half the cavity would be in one block and the other half in the second block. No undercuts were made in the cavity and the margins were not beveled. After the filling was inserted, the margins were examined under the microscope and the bolts were released, the two blocks were separated and the filling was removed for further examination, the one exception being the first filling described, which was one of noncohesive gold foil, which was retained in the original blocks for the tests.

The technic used was as follows: Noncohesive gold foil was used in pellet form and worked into the cavity with diamond point pluggers, hand pressure alone being used, the large plugger being used to wedge the foil into the cavity, new holes opened into the surface and more pellets added until it was impossible to add more. Then, with a small diamond point, attempts were made to make new openings into the surface. The entire surface was gone over with the point to locate if possible some weak spot. After the use of the small diamond point, a long-handled finishing bur was employed with rotary strokes, starting in the center of the filling and rolling it toward the margins. The entire surface was worked over in this manner and then the surface was finished with fine files.

The Brinnell hardness number for this particular filling was 72.2 and in one spot was 77. The best filling reported in the Bureau of Standards record shows a Brinnell hardness number of 61.

Another cavity was filled by the burnishing technic. This was a filling in which No. 4 cohesive foil in cylinder form was used. The entire filling was hand burnished and, when examined under the microscope, showed what appeared to be well adapted margins.

When tested in the Brinnell machine, the compression of the point in the center of the filling caused the gold to curl up around the point. With the second thrust of the point in another location, the gold pulled away from the margins along two walls. This proved that even if this method produces a thoroughly welded filling, the adaptation to the cavity walls is not made forcibly enough to effect a perfect seal. Also, if the case happens to be a contour restoration, the filling will move so under stress that

the original form will rapidly be lost.

A series of fillings were then made of various thickness of foil ranging up to 44-gage and finally 30-gage 24-carat plate used in strip form. An engine mallet was used with Black's plugger point No. 3, the strips of gold being from 1 to 2 mm. in width and from $\frac{1}{4}$ inch to 2 inches in length. The heavier foils were annealed by passage through the flame of an alcohol lamp until the color was cherry red. A comparison between the results obtained in using the heavier foils was particularly impressive. A filling made with a No. 44-gage plate had a Brinnell hardness number of 65 when polished on the completion of the malleting, while another filling, following the same steps with the addition of an engine burnisher used lightly on the surface, showed a Brinnell hardness number of 75.

Fillings made with 30-gage plate without burnishing showed a variation of from 34 to 72, or an average of 56 Brinnell hardness number. In the seven readings made, only one registered 34, the remainder being between 52 and 72. Burnishing of the surface of this heavier plate made a very slight difference in the hardness numbers.

One cavity was filled so that one half was 44-gage plate and the other half 30-gage plate. In checking, the same results were evident as when separate fillings were made. It was interesting to note that the thickness of the gold plate used had little effect on the hardness of the surface when mallet force alone was used, except that the 44-gage plate resulted in a more uniform hardness of the surface, the uniform average being 65 Brinnell hardness number. Burnishing of the surface raised the reading to an average of 75 for 44-gage plate fillings, as compared to hardly any increase in hardness when 30-gage gold plate was used.

Fillings were then made with No. 4 cohesive foil with a hand mallet and an automatic mallet for delivering the force on different sizes and shapes of plugger points. There was one notable point observed where mallet force was used: foil wedged against the margins was not displaced by the pressure of the point of the Brinnell machine. If there were soft spots in the mass of the filling, it was usually due to incomplete welding such as could be found in pits or in areas which would flake.

The practical application of the results of these observations led to further experiments.

Group 2.—In the second group of experiments, cavities were prepared in extracted teeth with cutting and finishing instruments advocated by different operators of today. These teeth were then sectioned to note (1) the form of the retention and convenience points in the dentin and (2) the finish of the enamel walls. For example:

1. A Class I cavity in a molar was prepared and the enamel margin was finished with a plain fissure bur.

2. A Class II cavity in a molar was prepared with all of the enamel margins finished with cutting instruments.

3. A Class III cavity in a central incisor was prepared, a 3-1-28 hatchet being used for making the incisal retention groove.

4. A Class III cavity in a central was prepared, a No. 35 inverted cone bur being used to make the incisal retention.

5. Another Class III cavity in a central incisor was prepared, Woodbury-Crandall angle formers No. 8 and 9, being used for preparing the gingival convenience points and the labial and lingual enamel walls finished by two different methods, the labial wall with a fine half round finishing file and the lingual wall with a No. 42 Wedelstaedt chisel.

These studies showed that many enamel walls are weakened and undermined by the use of certain instruments to such an extent that the smallest amount of wedging of foil into those cavities results in checking of the enamel radiating from the weakest points.

The enamel margins as finished by sharp cutting instruments showed definite and polished surfaces with clean-cut bevels. The fine file left a polished margin with the labio-incisal and labiogingival angles well rounded. The plain fissure bur on the walls of the occlusal cavity left the margins scalloped as compared to the uniform outline and finish of the occlusal enamel wall of the Class II preparation where a 42 Wedelstaedt chisel was used.

Another group of cavities were prepared as nearly as possible indentical with those used for the second group of experiments and made the basis for a practical application of some of the findings in the preceding experiments.

Group 3.—In the third group of experiments, the cavities were filled with No. 4 cohesive gold foil for the Class III preparations and a combination filling for the Class II preparation in which the No. 4 cohesive gold foil was used for the cavity in dentin and wedged up and over the enamel margins. The balance of the contour was then completed with gage No. 44 strip gold plate.

Different plugger points were used with automatic mallet force throughout the filling processes. It was interesting to note under the microscope the perfection of the adaptation of the foil to the margins and, in some cases, the checking of the enamel radiating from spots in the enamel which were weakened in the cavity preparation.

Plugger points were permitted to strike the enamel margins in certain locations and the crushing of enamel was noted after the fillings had been completed.

The teeth were then broken away from the fillings and the cavity portion of the fillings was examined under the microscope. This showed whether the retention and convenience points were completely filled and showed also that the foil was wedged into the dentin to such an extent that portions of the dentin remained embedded in the filling after its removal from the tooth.

The contour portions of these fillings were then tested for Brinnell hardness and showed results similar to those obtained in the first group of these experiments.

Illness prevented completion of the other experiments for this series, but before long I hope to present some further information which will make the use of gold foil simpler in application and of as lasting qualities as the fillings of the older master gold foil workers to whom we owe so much.

630 West 168th Street.

PATHOLOGY OF THE DENTAL PULP

By THOMAS J. HILL, D.D.S., Cleveland, Ohio

IN this paper, an attempt will be made to review the more important considerations associated with pathologic changes of the dental pulp which may be misunderstood or are controversial and to contribute some new information to an understanding of these conditions.

In a general way, pathologic changes are the same in a dental pulp as in other parts of the body, but, in addition, there are local conditions which contribute to the incidence and severity of injuries to the pulp. These conditions are: inability of the protecting tissue to repair itself, lack of collateral circulation and definite encasement within unyielding walls.

The functions of the pulp are: the formation of dentin, the maintenance of vitality of the dentin and the conveyance of sensation. In adult life, when the first of these functions, formation of the dentin, stops, or is reduced to a minimum, histologic changes take place, so that the structure of a normal pulp varies with advancing age. There is a progressive decrease in the number of pulp cells and a gradual increase in the amount of connective tissue. These changes are retrogressive and the rapidity of their occurrence is increased by external irritation such as from caries, abrasion, pyorrhea and trauma. Figure 1 is a photomicrograph of a pulp from an unerupted third molar of a 21-year-old patient. It is composed of loosely arranged well-vascularized embryonal tissue and contains the usual number of pulp cells. The odontoblasts are regular in outline and of average height and the predentin is of normal width.

Figure 2 is a photomicrograph of an upper lateral incisor which was carious, with slight recession of the gum, also from a patient 21 years old. The pulp cells are decreased in number and much of the embryonal tissue is replaced by fibrous connective tissue. The arterioles have greatly thickened walls and there are areas of perivascular round-cell infiltration and a small amount of fat infiltration. The odontoblasts are lost and no predentin is present. The regressive change is severe and indicates that the pulp has been subjected to injuries for a prolonged period.

Figure 3 is a photomicrograph of a caries-free, pyorrheal upper lateral incisor from a patient 41 years old. In this pulp, the embryonal tissue has been replaced by hyalinized connective tissue and contains but few stellate cells. This pulp also has been subjected to irritation over a long period and represents the histologic changes commonly found in advanced pyorrhea. Comparable changes are found in teeth from people of ad-

*From the Institute of Pathology, Western Reserve University.

*Read at the Seventy-Fifth Annual Session of the American Dental Association in conjunction with the Chicago Centennial Dental Congress, Aug. 10, 1933.

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vanced age in whom there is no evidence of external irritation other than normal function.

The pulp can, within some limitations, react to these irritants with progressive changes, such as tubular calcification, the formation of secondary dentin and possibly calcification of the pulp tissue itself.

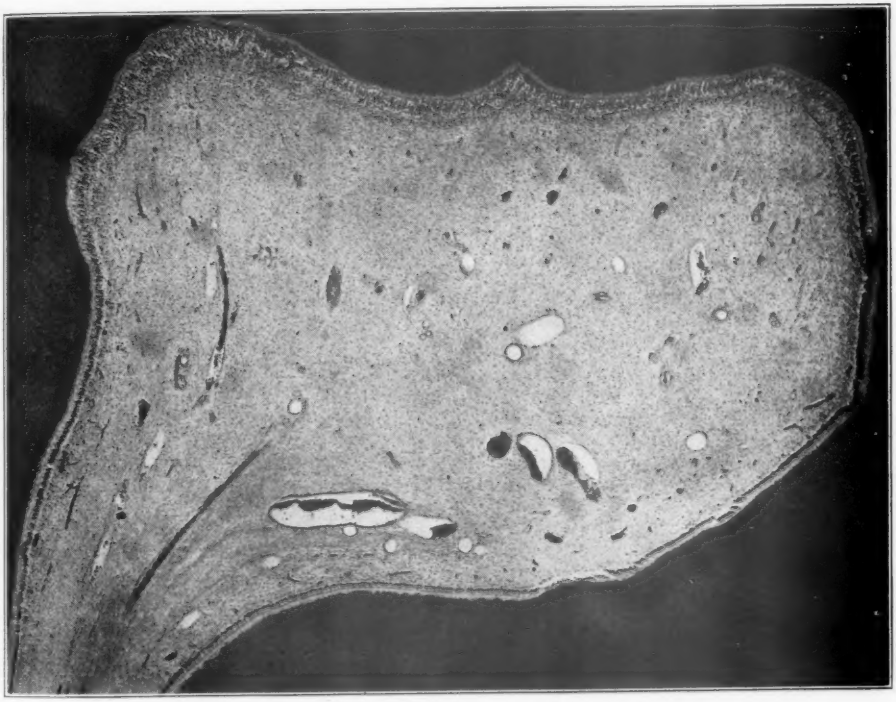

Fig. 1.—Normal pulp of unerupted third molar from a 21-year-old patient. (×30.)

Under the stimulation of active caries, calcium is deposited within the dentinal tubules. The location of this deposition is known as the transitional zone, the reactionary zone or the zone of sclerosis.[1] It has previously been believed that this transparent zone is the result of the direct deposition of calcium by Tomes' fibers or by calcification of the Tomes' fibers themselves, but Weber[2] and also Euler[3] have recently demonstrated that the presence of fat precedes calcification. This indicates that the deposition of calcium is the result of a degenerative process rather than a physiologic deposition by Tomes'

1. Beust, T. B.: Reactions of Dentinal Fibril to External Irritation, J.A.D.A., 18:1060 (June) 1931.

2. Weber, R.: Neue Untersuchungen über das Auftreten von Fett im Zahn, Deutsche Monatschr. f. Zahnheilk., 48:1489, 1930.

3. Euler, H., quoted by Kronfeld, R.: Histopathology of Teeth and Their Surrounding Structures, Philadelphia: Lea & Febiger, 1933; p. 89.

fibers. It must be recognized that this deposition does not occur in pulpless teeth. The impermeability of the reactionary zone to dyes (Fish[4]) suggests that the tubules have been blocked, and therefore would retard the progress of caries and obstruct the irritating influence of caries on the pulp.

The extent of this transparent zone is greater in young individuals and in teeth wherein the penetration of dental caries is slow. In early caries of the dentin, beneath the reactionary zone, pulps may be found which are histologically normal, but when the carious process is rapid, or the penetration is deep, alteration of the pulp is found. In the first case, secondary dentin is formed in response to a mild stimulation, and in the latter case, the irritation of the pulp causes reactions which are destructive in nature.

Such irritations as those caused by caries and abrasion, if not too severe, may stimulate the pulp to increased activity. The functional ability of the pulp as far as the formation of secondary dentin is concerned may be estimated by the width of the area of predentin, which, when calcification is normal, is in proportion to the activity of the odontoblasts. Fish[4] has stated that, in the histologic examination

Fig. 2.—Pulp of carious incisor having recession of gum, from 21-year-old patient; illustrating retrogressive changes. (×100.)

4. Fish, E. W.: Pathology of Dentin and the Dental Pulp, Brit. D. J., 55:351 (March) 1932.

of pulps beneath caries and secondary dentin, reduction in the number or complete loss of odontoblasts is frequently seen. He states that tubular dentin is formed when the odontoblasts have survived the injury and hyaline dentin is formed when the odontoblasts are lost. Examination of our material shows a close relationship between the proportional amount of predentin and the number and structure of the odontoblasts.

Figure 4 is a photomicrograph of a cross-section of the pulp of a noncarious lower incisor taken from a 26-year-old patient. In the central portion, the odontoblasts are lost and there is no predentin. At either extreme, where predentin is present, the amount is in proportion to the height of the odontoblasts. We have observed, particularly in adult teeth and in the teeth from individuals of advancing age, that the height of the odontoblasts

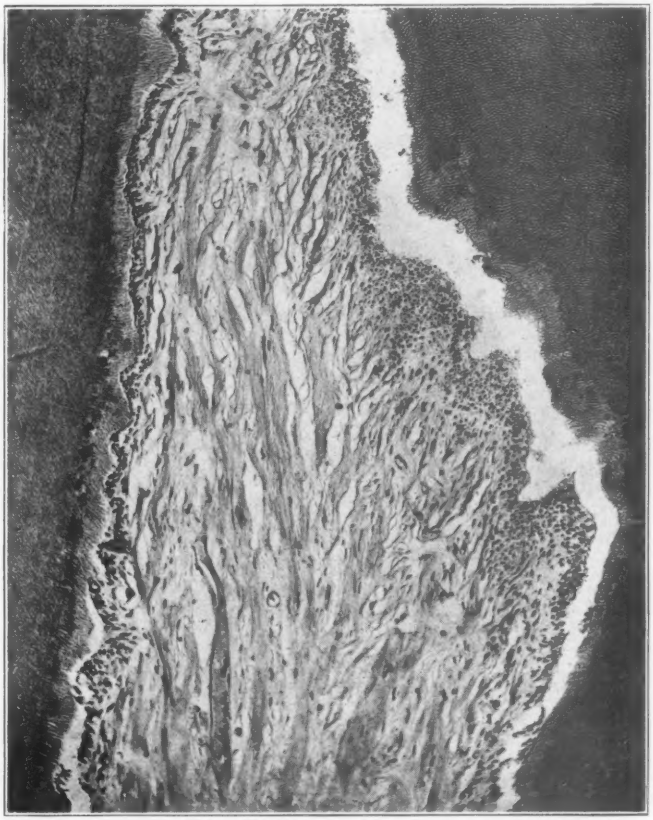

Fig. 3.—Pulp of caries-free pyorrheal lateral incisor from a 41-year-old patient; illustrating histologic changes commonly found in advanced pyorrhea. (×120.)

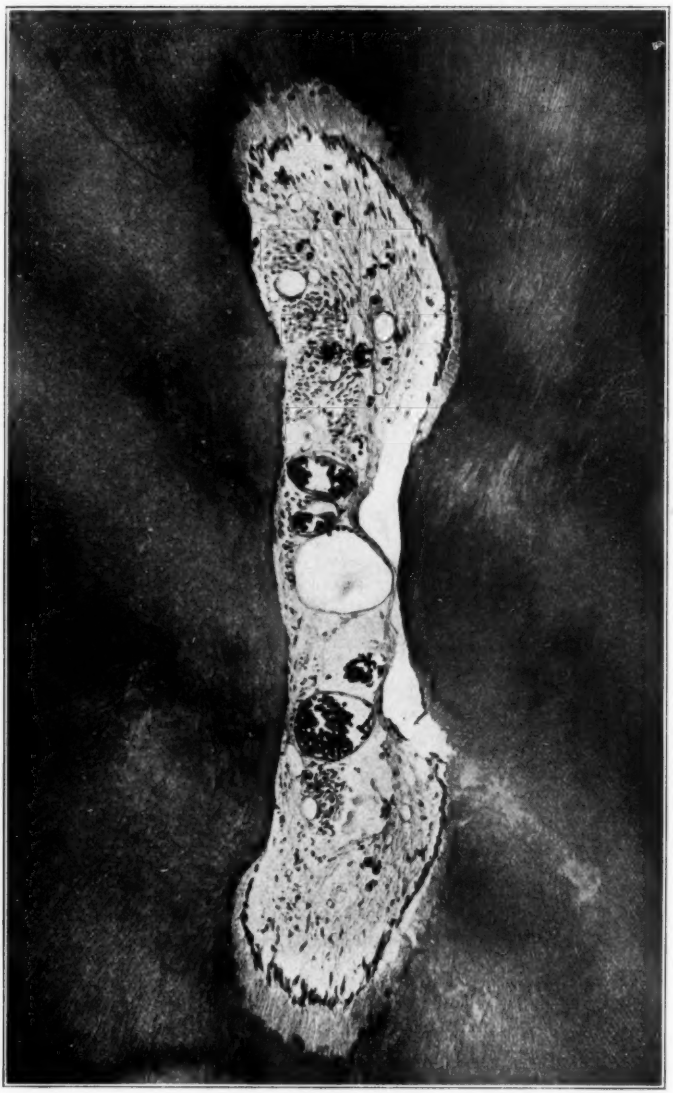

Fig. 4.—Pulp and dentin of lateral incisor from patient 61 years of age; illustrating formation of dentinal substance by accretion of calcific bodies which have been formed within pulp. (×220.)

decreases toward the apical end of the tooth, and with it is seen a decrease in the thickness of the predentin. In some teeth, and especially in those which show fibrosis and some degree of calcification, the odontoblasts are completely lost in the radicular portion and a dentinal substance has been formed by an accumulation of calcific deposits within the pulp which have become adherent to the dentinal wall. This dentinal structure is neither tubular nor hyaline, but globular in character. Figure 5 is a photomicrograph of the pulp and dentin of a lateral incisor from a patient 61 years of age. The tooth was without caries, prostheses or pyorrhea. The pulp shows a marked decrease in the number of cells and a moderate degree of hyalinization, but no increase in the thickness of the vessel walls. In the depicted portion of the canal, there are no odontoblasts present, but calcareous bodies have been formed within the pulp and become adherent to the dentin wall. This dentinal material has been formed at the same rate of speed as the tubular dentin toward the coronal portion of the tooth, where odontoblasts

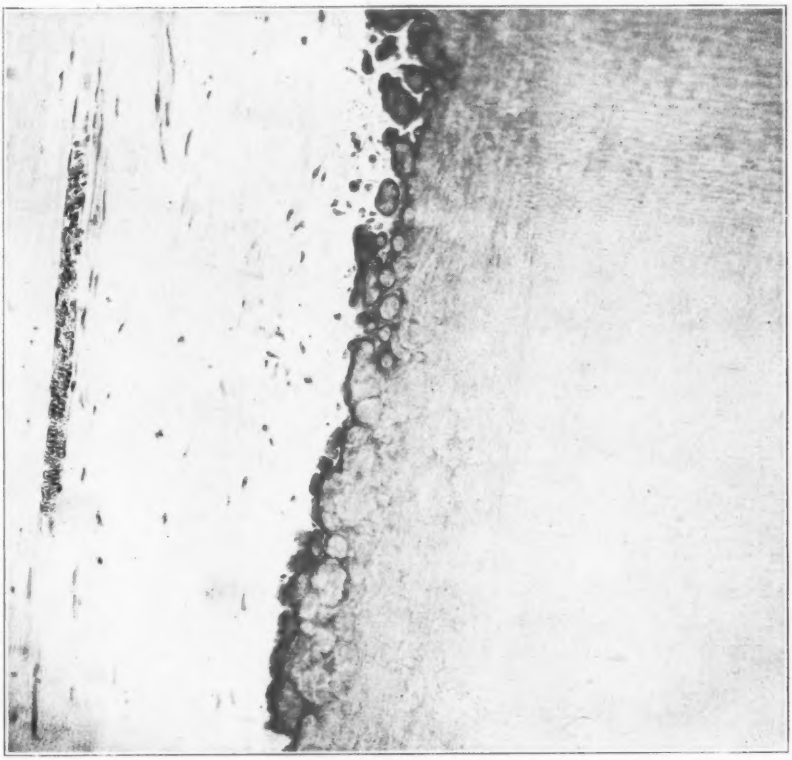

Fig. 5.—Early reticular atrophy of pulp. (×120.)

and predentin are seen. We interpret this condition as the formation of calcific deposits within the pulp which, by the increase in their size, have become part of the dentin wall. Such calcific deposits are to be more fully discussed later in this paper.

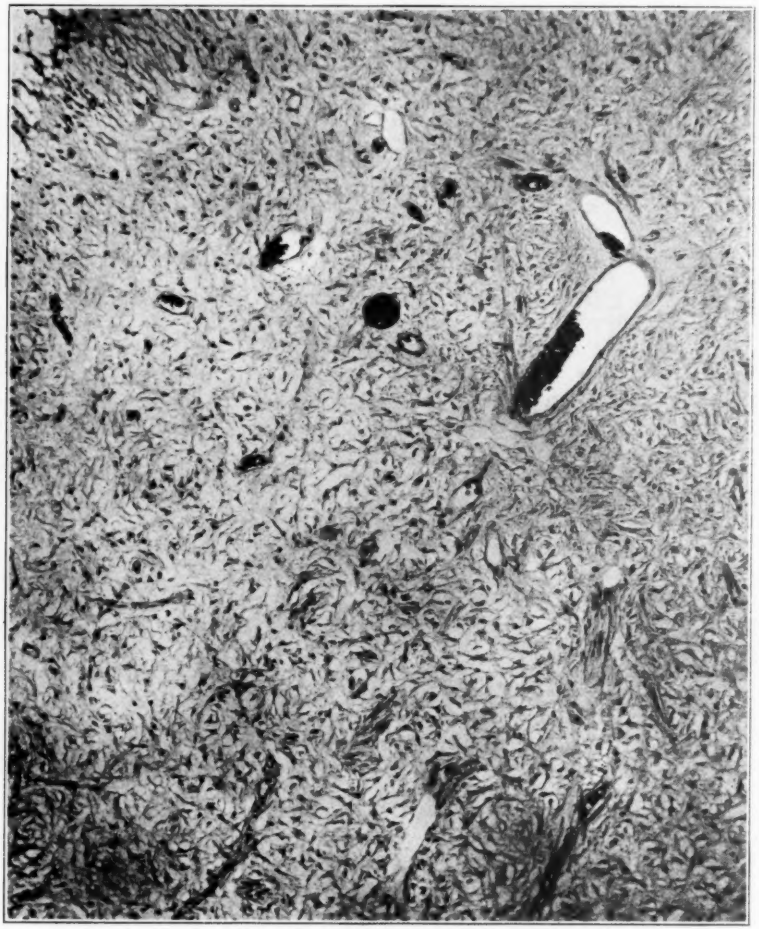

Fig. 6.—Reticular atrophy of pulp. (×120.)

Vacuolization of the odontoblastic layer is frequently observed in adult teeth. This vacuolization is believed by Willman[5] and others to be a regressive process which is often found with advancing age. Similar vacuolization of odontoblasts has

5. Willman, Warren: Changes in Dentin and Pulp Produced by Caries and Dental Restorations, abstr. J. D. Res., 12:460 (June) 1932.

been described by Wolbach and Howe[6] in experimental scurvy in rats. That such changes do occur there can be no doubt, but careful study of our material reveals the fact that histologically similar vacuoles can be produced by improper fixation of pulp tissue. Good fixation of pulp tissue can seldom be attained by placing extracted teeth *in toto* in a fixative. We obtained satisfactory fixation of dental pulps by immediate grinding of the side of the tooth under water until the coronal pulp was freely exposed and then placing it in 10 per cent formalin or Bouin's fixative. Realizing that immediate penetration of the pulp by the fixative is necessary, early in our study of pulps we cut off part of the radicular portion of the tooth. We found that, in the coronal horns, in many cases, vacuolization of the odontoblasts occurred over a normal thickness of predentin. This we believe to be an artefact due to poor fixation, a diffi-

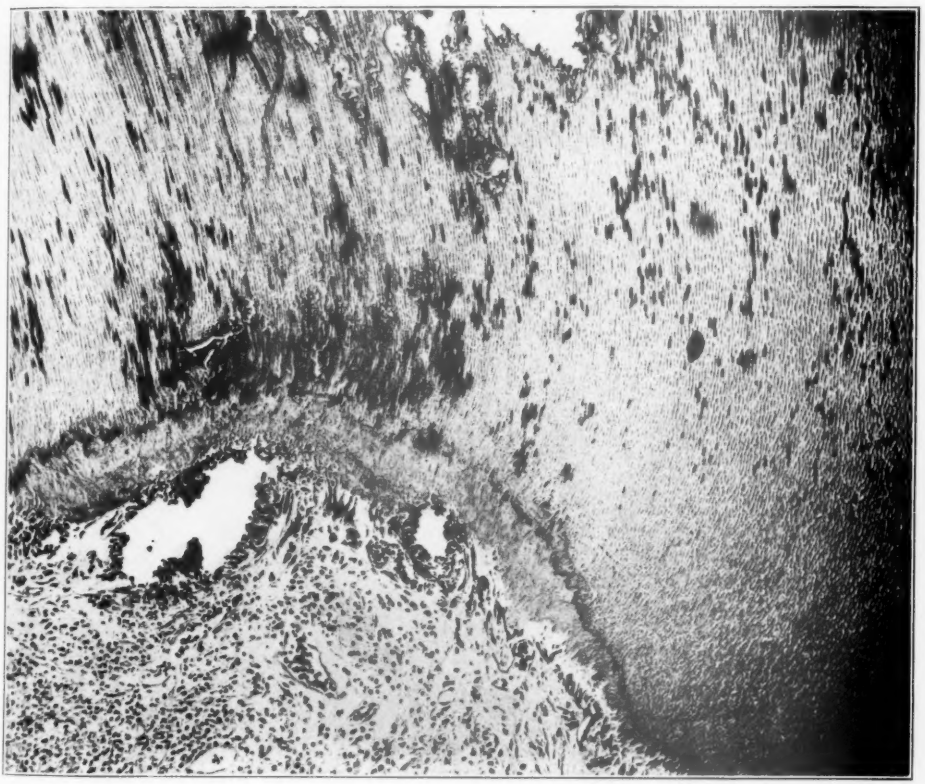

Fig. 7.—Penetration of caries through dentin and resultant inflammatory reaction in pulp. (×110.)

6. Wolbach, S. B., and Howe, P. R.: Intercellular Substances in Experimental Scorbutus, Arch. Path. & Lab. Med., 1:1 (Jan.) 1926.

culty overcome in large part by free opening of the pulp. When with proper fixation vacuolization of the odontoblasts is found accompanied by a diminution in the amount of predentin, which indicates a decrease in the functional ability of the odontoblasts, the condition is clearly degenerative. Vacuolization of the odontoblasts is usually accompanied by reticular atrophy of the parenchyma of the pulp. Figure 6 illustrates early reticular atrophy, which consists of an increase in collagenous material and the formation of small vacuoles. As the severity of this condition increases, the vacuoles become larger and the collagenous material is aggregated into denser strands, always accompanied by a diminution in the number of pulp cells.

Euler[7] and Schneider[8] have described cystic areas within the pulps of clinically intact teeth where the odontoblastic layer had separated from the dentin to form the cavity. Hammer,[9] who has made a study of this condition, believes that the cysts which he has seen and which are formed by the dentin wall on one side

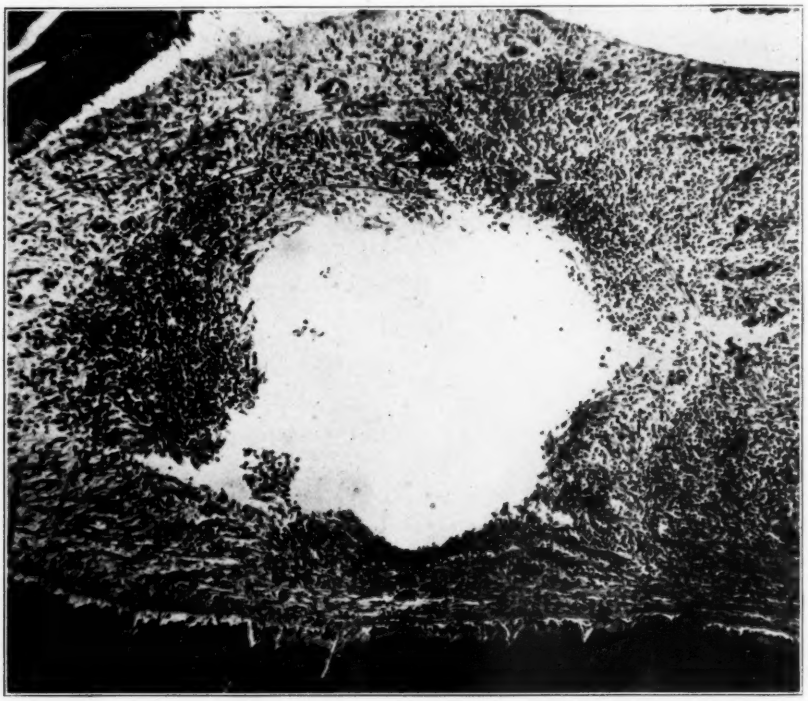

Fig. 8.—Localized abscess in pulp of carious molar. (×100.)

7. Euler, H.: Über Zystenbildung der Pulpa, Ztschr. f. Stomatol., 28:1019, 1930.

8. Schneider: Zur Frage der Pulpacysten, Deutsche Monatschr. f. Zahnheilk., 50:1089, 1932.

9. Hammer, H.: Zur Frage Pulpacysten. Deutsche Monatschr. f. Zahnheilk., 50:1089, 1932.

and the odontoblasts on the other, were without signs of degeneration of the surrounding cells and are the result of shrinkage due to technical methods. We have seen examples of such cysts in our preparations which, in addition to the lack of degenerative manifestations in the pulp tissue, had areas of predentin normal in width. These observations indicate that the odontoblasts had functioned normally and tend to confirm the conclusions of Hammer.

Hyperemia of the pulp easily and frequently results from thermal and chemical irritation following the loss of the protecting tissue. Clinically, hyperemia of the pulp is characterized by paroxysms of pain on subjection of the tooth to irritating influences. Sudden rushes of blood into a tissue encased within rigid walls

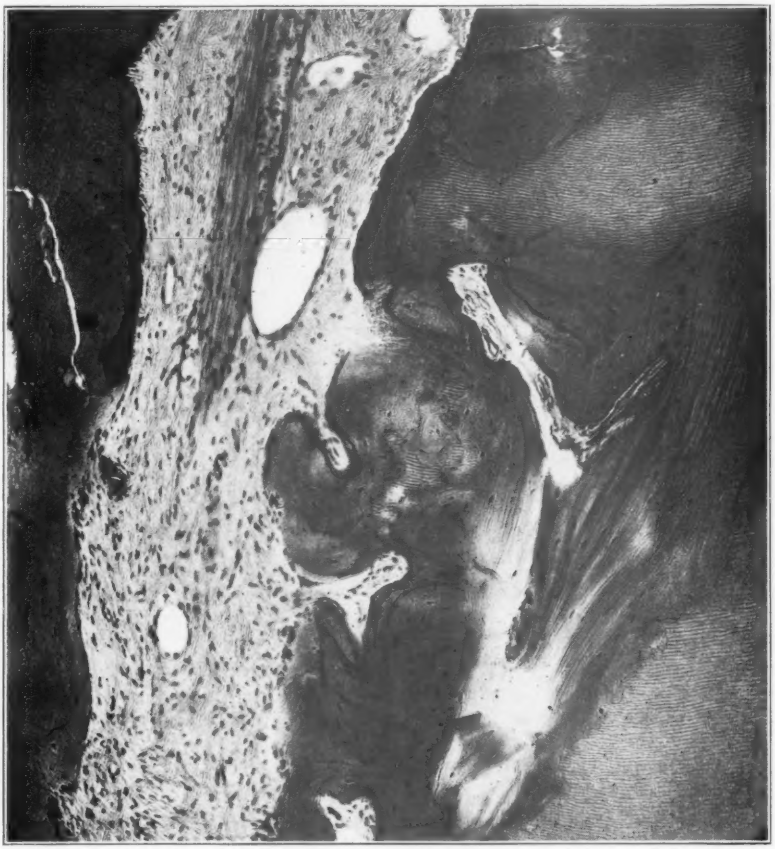

Fig. 9.—Resorption of dentin and replacement by bone. (×120.)

cause a pressure which is relieved with the removal of the irritation and the subsequent equalization of blood pressure. These conditions are readily amenable to treatment by proper protection of the pulp. It is probable that long-continued hyperemia of thermal or chemical origin might result in degenerative changes. There is little or no laboratory evidence that pulps die because of hyperemia produced by the thermal conductivity of large metallic restorations.

Fig. 10.—Calcification of hyalinized connective tissue. (×370.)

Caries sufficiently deep to require restorations extensive enough to cause thermal shock is likely to result in bacterial invasion of the pulp. This is the most

important factor in the death of such pulps. Most forms of pulp inflammation and degeneration are the direct result of bacterial invasion of that tissue. Bacterial occupation of dental tubules in advance of the necrotic areas of caries has repeatedly been shown and bacteria within the pulp under areas of caries are sometimes demonstrable. Henrici and Hartzell,[10] in a study of pulps of carious teeth, found in all some histologic change, either inflammation or fibrosis. They concluded that pulps are subjected to repeated injur-

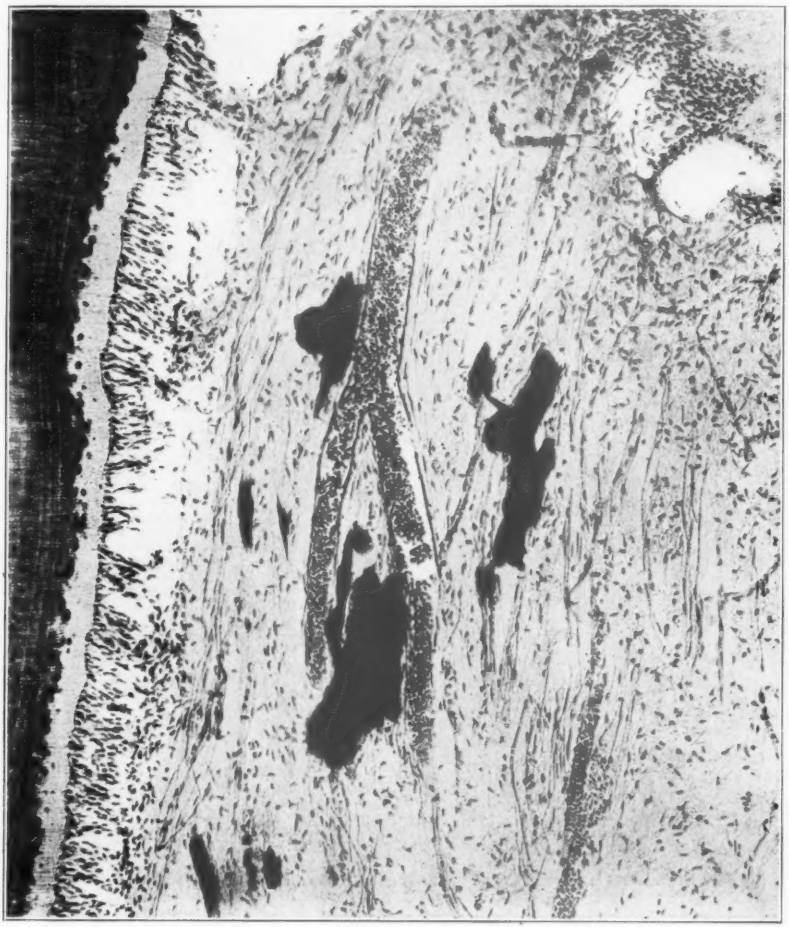

Fig. 11.—Perivascular calcified bodies in pulp. (×140.)

10. Henrici, A. T., and Hartzell, T. B.: Microscopic Study of Pulps from Infected Teeth, J.A.D.A., 8:213 (March) 1921.

ies over a long period before they undergo degeneration. It cannot be inferred that all histologic change found in pulps of teeth with caries is the direct result of bacterial invasion of the pulp, because some change may result from products of bacterial activity or the products of caries.

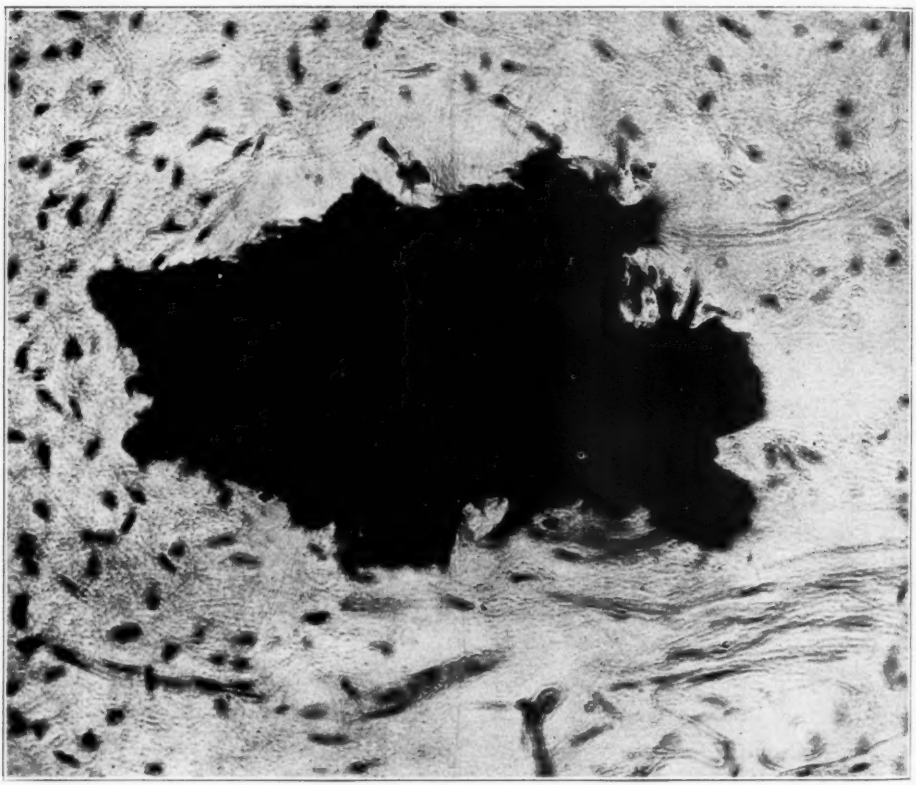

Fig. 12.—Calcified mass showing calcification of marginal collagenous fibrils. (×385.)

It is evident that the proximity of caries to the pulp bears a direct relationship to the pathologic change found within the pulps.

The most common pathologic change found within dental pulps is inflammation. Inflammations of the pulp *per se* are comparable to inflammations in other parts of the body. Before actual exposure of the pulp occurs, sometimes even in superficial caries, infection of the pulp through dental tubules may take place and areas of inflammatory reaction are seen just beneath the odontoblastic layer. Figure 7 is a photomicrograph of the carious portion of a tooth illustrating the penetration of caries through firm dentin and the resultant inflammatory reaction in the pulp. These reactions are at first confined to a small area of the pulp and are characterized by the presence of serous

Fig. 13.—Corpora amylacea in pulp of carious tooth. (×1160.)

exudate and of polymorphonuclear leukocytes. Seldom does resolution occur. The inflammation usually increases in severity and extent of area involved. It may be

manifested as a localized abscess immediately beneath the area of infected dentin or the inflammatory process may involve the entire pulp. In areas of localized pulp abscesses, bacteria are easily demonstrable in microscopic sections. This type of pulp infection is clinically accompanied by prolonged pain which is exaggerated on the application of thermal or chemical irritation, the severity of which gradually

Fig. 14.—Calcification around and in neighborhood of corpora amylacea. (×1160.)

decreases over a lengthy period of time.

This partial or localized pulpitis may result in slow progressive necrosis of the pulp provided the caries has caused an exposure and permitted an opportunity for accommodation of inflammatory swelling. Owing to the encasement of the pulp within unyielding walls and its consequent inability to accommodate vascular change, total pulpitis will result in stasis of the blood stream and thrombosis. Under these conditions, complete death of the pulp will occur in as short a period of time as forty-eight hours.[11] The clinical symptoms of total pulpitis are steady pain, increasing difficulty in localizing the tooth and a decreasing response to cold with an increasing response to heat. Figure 8 is a photomicrograph of a pulp of a deeply carious molar tooth. It has a localized abscess in the central portion and inflammatory cellular exudate throughout the coronal portion of the pulp.

The influence of silicate cements on the pulps of teeth was recently summarized as follows[12]:

> The death of pulps beneath silicate cement fillings has long been a clinical observation. The cause of the death of these pulps has been the subject of some controversy and, as yet, is only partially understood. The use of synthetic enamels is largely confined to anterior teeth. As the death of pulps beneath fillings is well known to be more frequent in anterior than in posterior teeth, it is quite possible that many pulps that have died beneath silicate fillings would have died beneath other fillings. There is little available evidence which helps to distinguish between pulps that die because of approaching caries and those that die because of the irritation caused by the silicate cements. The theories that the pulps beneath silicate cements die because of the heat generated by the chemical action of phosphoric acid and the oxides of silicon, aluminum or calcium, or by the hygroscopic action of these cements during the setting period, have not been substantiated by scientific evidence.

Palazzi[13] conducted a series of experiments by using silicate cements in the teeth of dogs. He found definite changes in the pulps after from twenty to forty days. These changes were manifested as hemorrhage, reticular atrophy and fibrosis.

Rohrer,[14] in an article on the effects of silicate cements on protoplasm, agrees with Palazzi that silicate cements have an injurious effect on the dental pulp. He suggested that the results obtained by the experiments of Palazzi might be exaggerated because in the teeth of dogs cavities were mechanically made and consequently lacked the reactionary zone of dental caries.

G. Fasoli[15] conducted a series of experiments on dogs by preparing cavities of various depths and filling these cavities with cement. After a period of time had elapsed, the pulps were examined microscopically. Some of his conclusions were:

1. Pulps exhibit no harmful reaction to the use of zinc phosphate cements.
2. The use of silicate cements in deep cavities produces hyaline and reticular degeneration and definite areas of necrosis in from thirty to forty days.
3. When silicate cements are used in cavities less deep, the pulp exhibits dis-

11. Römer, O.: Erkrankungen der Zahnpulpa taken from "Die Pathologie der Zähne, p. 231, Handbuch der Speziellen Pathologische Anatomie und Histologie (edited by F. Henke and O. Lubarsch), Vol. 4, Berlin: Julius Springer, 1928.

12. Hill, T. J., and Van Natta, H. C.: Review of Researches on Protection of Vital Pulps, Proc. Am. A. D. Schools, March, 1932, p. 273.

13. Palazzi, S.: Über die Anatomischen Veränderungen Zahnpulpa in gefolge von Silikatzement füllungen, Ztschr. f. Stomatol., 21:279, 1923.

14. Rohrer, A.: Action of Silicate Cements on Protoplasm, Brit. D. J., 45:196 (Feb. 1) 1924.

15. Fasoli, G.: Silikatzemente und Pulpaveränderungen, Ztschr. f. Stomatol., 22:225, 1924.

turbance of the capillaries with the production of hemorrhagic infarcts and the formation of areas of serous exudate in the central portion of the pulp. Abnormal production of secondary dentin is found in these teeth. In this series of experiments, the changes followed a slower course and the remote portions of the pulp were unaffected.

4. The lesions in the pulp are not limited to the regions directly beneath the cavity.

5. Silicate cement contains some substance harmful to the pulp. Free phosphoric acid could not be demonstrated to be the main factor. It was either absent or negligible after the cement had been allowed to set for fifteen minutes, but there was apparently a soluble acid salt of phosphoric acid present.

6. Some protecting substance must be used between the pulp and the silicate cement and oxyphosphate cements are entirely satisfactory for this purpose.

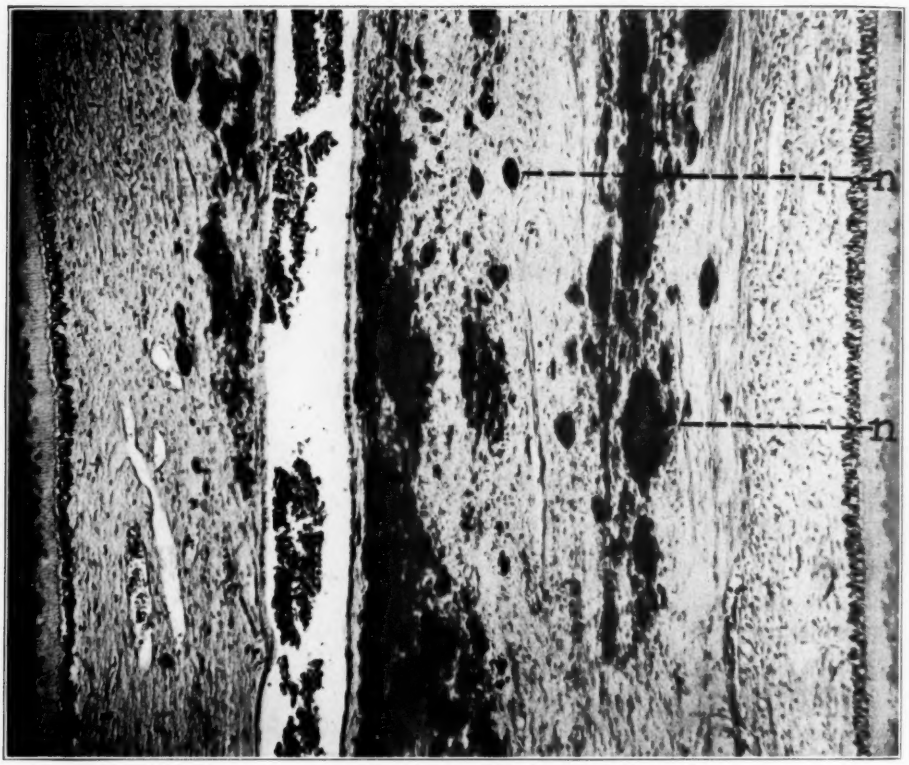

Fig. 15.—Calcification, showing nidi in pulp of carious bicuspid. *n*, nidi. (×90.)

Internal resorption of the walls of the pulp chamber is occasionally found. It is not so common as external resorption of the root surface and seldom is it so exten-

sive. Its etiology is obscure. Most cases of internal resorption are repaired by the filling in of the lost area with a substance similar to cementum or bone. Figure 9 is a photomicrograph of a pulp of a lower lateral incisor having distal caries and advanced pyorrhea, from a patient 48 years old. The photograph is made of the central third of the root canal. The pulp exhibits no marked pathologic change. The areas of resorption have taken place. The resorption has been largely repaired by replacement with bone. While the origin of such bone in the repair of the dentin may be controversial,[16] it is worthy of note that, in this tooth, the bone can be traced along the sides of a lateral canal to a point near the cementum. This might support the belief that it has its origin in the peridental membrane, although

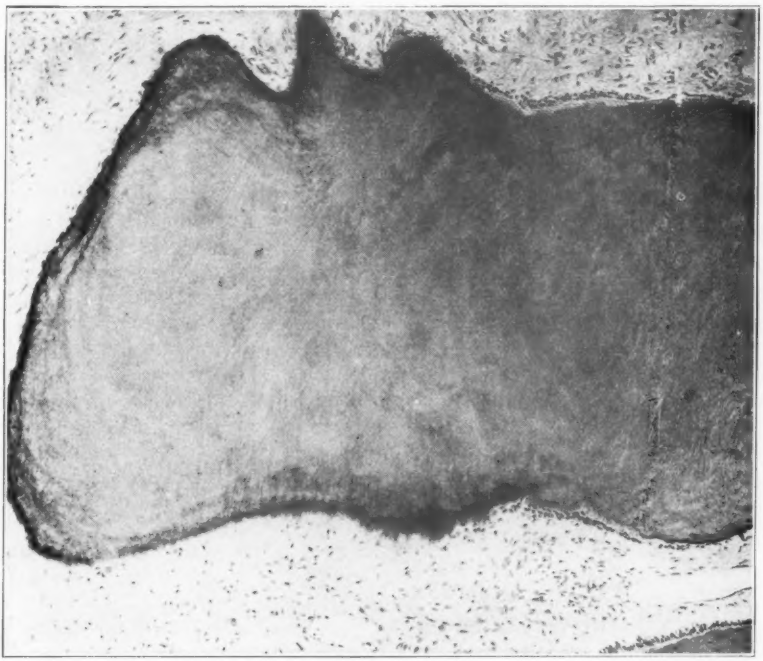

Fig. 16.—Calcification within pulp; showing atypical odontoblasts and small amount of predentin. (×100.)

number of pulp cells and the amount of connective tissue are normal. A few small areas of calcification are present. The odontoblasts are lost, but this condition is not uncommon in this portion of the root canal at this age. The marked change is in the dentin, where extensive there is nothing inconsistent in the theory that such conditions are the result of metaplasia.

Calcification within the pulp has been the subject of much discussion in relation

16. Euler, H.: Metaplasie der Pulpa, Vierteljahrsschr. f. Zahnheilk., 37:303, 1933.

to its importance as an etiologic factor in obscure facial neuralgia. In the microscopic examination of 132 teeth, we have found calcification in 80 per cent of the pulps. This percentage is in keeping with the observations made by Kronfeld.[17] The age distribution in our examination of teeth is shown in the accompanying table.

It will be observed that calcification is common in young individuals and that there is a gradually increasing tendency to the condition with advancing age. We have observed these areas of calcification in unerupted and newly erupted teeth.

The great frequency of calcification within the pulp and the inability to interpret roentgenograms with sufficient accuracy to recognize but a small percentage of them would lead one to question the results arrived at in an investigation of pulp calcification based wholly upon roentgenographic evidence.[18] It is recognized that there is some clinical evidence to support the common belief that the removal of teeth showing pulp calcification has, in certain instances, relieved facial neuralgia. This relationship or the relationship between pulp calcification and other systemic disease has not been definitely established. If it were possible to establish such a relationship, roentgenograms would be of aid in the recognition of only a few of the larger areas of calcification.

AGE DISTRIBUTION OF CALCIFICATION IN PULPS OF ONE HUNDRED AND THIRTY-TWO TEETH

No. Teeth Examined	Age Years	No. Teeth Showing Calcification	No. Teeth Showing No Calcification	Percentage
9	10-20	6	3	66
30	20-30	20	10	66
16	30-40	13	3	80
46	40-50	38	8	82.6
20	50-60	18	2	90
11	60-70	10	1	90

There are three types of calcification of the dental pulp,[19] each formed through different pathologic processes, the recognition of which is possible only by use of the microscope. In this paper, the use of the common terms for the products of these types of calcification such as denticles, pulp stones, pulp nodules and calculi, will be avoided, because no one is generally applicable to the various classes of calcification, which are:

1. Pulp calcification caused by an infolding of the odontoblasts during the development period. This infolded region becomes separated from the main body of the odontoblasts and islands of dentin are formed. This type of calcification results entirely in the formation of dentin. Such calcification within the pulp has been described by Fridrichowsky[20] and by Wolbach and Howe[21] in vitamin A deficiency in rats. Similar infolding was previously described in vitamin C deficiency in guinea-pigs. It is probable that this is not an important type of calcification in human teeth because we seldom see calcification of the pulp resulting entirely in dentin formation.

2. Calcification areas within the pulp which are the result of calcification of hyalinized connective tissue. Figure 10

17. Kronfeld, Rudolf: Histopathology of the Teeth and Their Surrounding Structures, Philadelphia: Lea & Febiger, 1933; p. 57.

18. Stafne, E. C., and Szabo, S. E.: The Significance of Pulp Nodules, D. Cosmos, 75:160 (Feb.) 1933.

19. Ottolengui, Rodrigues, and Cahn, L. R.: Pathologic Conditions Discovered Within Pulps of Unerupted, Impacted and Imbedded Teeth, D. Items Int., 48:897 (Dec.) 1926.

20. Fridrichowsky, H.: Zur Histologie der Dentikel, Ztschr. f. Stomatol., 25:124, 1927.

21. Wolbach, S. B., and Howe, P. R.: Incisor Teeth of Albino Rats and Guinea Pigs in Vitamin A Deficiency and Repair, Am. J. Path., 9:275 (May) 1933.

is a photomicrograph of the pulp of a pyorrheal tooth from a patient 50 years old. It illustrates the calcification of hyalinized connective tissue. This type of calcification, which is usually perivascular or perineural, is frequently found associated with fibrosis of the pulp. An example of this condition is found in Figure 11, a photomicrograph of a pulp of a pyorrheal tooth from a 50-year-old patient. Figure 12, a photomicrograph of a tooth from the same patient, shows a large calcification area with marginal calcification about the collagenous fibrils. Similar calcification areas in a more granular form can be observed within the walls of the arterioles of the pulp in Figure 19.

3. Calcification which begins as a deposit of calcium salts in corpora amylacea. Figure 13 illustrates corpora amylacea[22] within the pulp of a carious tooth from a patient 29 years old. Corpora amylacea

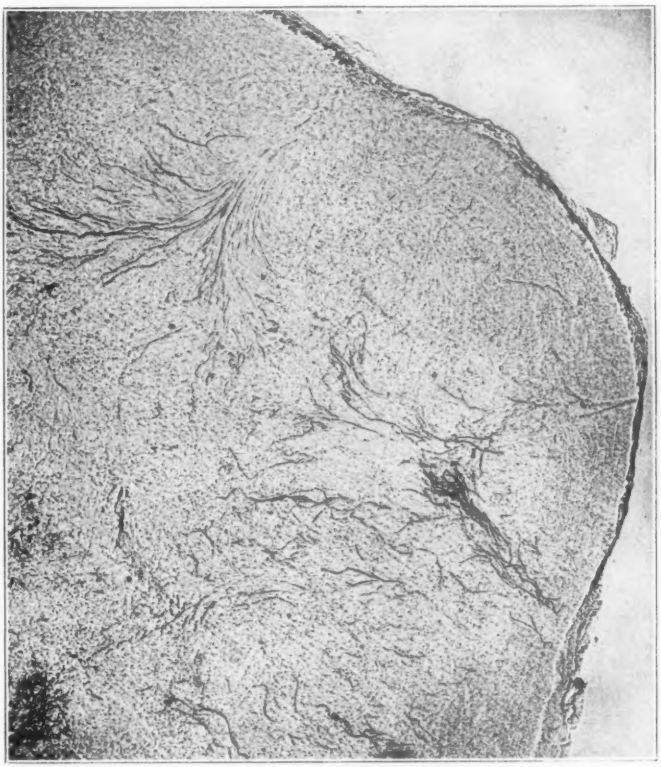

Fig. 17.—Unstained ground section; showing irregularity of dentinal tubules. (×100.)

22. Römer, O.: Erkrankungen der Zahnpulpa, Die Pathologie der Zähne, p. 266, Handbuch der Speziellen Pathologische Anatomie und Histologie (edited by F. Henke and O. Lubarsch), Vol. 4, Berlin: Julius Springer, 1928.

occur as concentrically lamellated bodies of irregular size and stain metachromatically, with methyl violet. Their origin is probably in degenerated nuclear fragments. Figure 14, a photomicrograph taken from the same tooth, illustrates a granular deposition of calcium around

content is distributed in uneven lamellation. When these calcification areas are cut through the center, a nidus is always demonstrable. Figure 15 is a photomicrograph of a pulp canal of a carious bicuspid tooth from a patient 47 years old. It illustrates extensive calcification of this type,

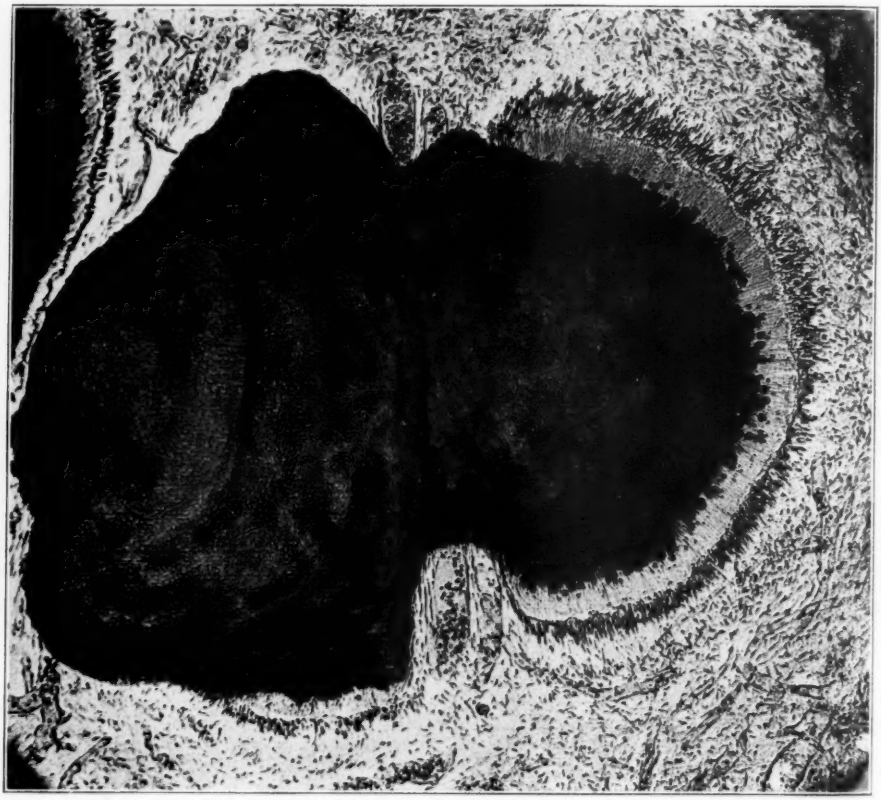

Fig. 18.—Calcification in pulp; showing well-organized odontoblasts, wide border of predentin and regular dental tubules. (×130.)

and in the immediate neighborhood of the corpora amylacea. By concrescence and by conglomeration, these deposits increase in size. The uneven staining in this type of calcification indicates that the inorganic

and also the nidi in those calcification areas that have been cut through the center. This is the type of calcification which was responsible for the building of a dentinal substance onto the dentin wall,

previously described in this paper and illustrated in Figure 5.

Most of the larger calcification areas contain dental tubules and at their margins odontoblasts are found. Euler,[23] Kronfeld[24] and Neuwirt[25] believe that these odontoblasts do not arise in the odontoblastic layer but are formed from the stellate cells of the pulp. These odontoblastic cells are usually of a lesser height and are either cuboidal or round. They form irregular dentin and, from the small amount of predentin usually present, one would believe the formation of dentin to be slow. That there is a tendency for odontoblasts to form around calcific areas in the pulp is further exemplified by the works of Neuwirt[25] and of Feldmann.[26] They demonstrated, in mechanical exposure of the pulp, where fragments of dentin had been forced into the pulp, that odontoblasts arising from the stellate cells of the pulp form around these fragments and further deposition of dentin is made. Figure 16 is a photomicrograph of the pulp of a carious molar tooth from a patient 29 years old. Small odontoblasts are seen over portions of the calcification area, which has a thin area of predentin. At other margins of this area, the increase in size appears to be by accretion and by calcification about the collagenous fibrils. Figure 17, an unstained ground section of an area of pulp calcification, illustrates the irregularity of the formation of dental tubules.

Calcification areas occasionally show well organized odontoblasts, the activity of which is evidenced by the wide area of predentin and the regularity of the dental tubules. Such a condition is illustrated in Figure 18, taken from a 44-year-old patient who had pyorrhea. Figure 19 is a photomicrograph of a pulp of a molar tooth which had mesial caries and an occlusal filling, in a patient 19 years old. It illustrates the centers of calcification which have become fused and further united by the formation of a dentinal substance having tubules. This is the most common composition and arrangement of large calcification areas within the pulp. It also illustrates calcific deposits within the walls of arterioles, which have been previously described in this paper. Figure 20 is a photomicrograph of the pulp of an abraded molar tooth from a 42-year-old patient who had pyorrhea. It illustrates the extent to which calcification of the pulp occurs and the attachment of the calcification area to the dentin wall. This attachment is usually by the formation of dentin around the calcification area. Except for the calcification and some fibrosis, which is comparable to the amount usually found in the fifth decade of life, no marked pathologic change is observed in this pulp.

23. Euler, H.: Sekundäre Odontoblastenbildung, Deutsche Monatschr. f. Zahnheilk., 45: 488, 1927.

24. Kronfeld, Rudolf: Footnote 17, p. 55.

25. Neuwirt, F.: Die Reparativen Fähigkeiten der Pulpa, Ztschr. f. Stomatol., 31:291, 1933.

26. Feldman, G.: Neue Wege in den Therapie von Zähnen mit Entzündeter Pulpa, Vierteljahrsschr. f. Zahnheilk., 48:211, 307, 1932.

SUMMARY

1. Throughout life, there is a gradual histologic change in the pulps of teeth. The amount of embryonal tissue and the number of stellate cells become reduced. There is increased fibrosis, which is hastened by pyorrhea, caries and abrasion.

2. Hyperemia may be produced by thermal shock, but there is evidence that bacterial invasion is the most important etiologic factor in the death of pulps.

3. Formation of secondary dentin and tubular calcification act to retard the progress of caries.

4. The rapidity with which dentin is formed in adult teeth may be estimated

Fig. 19.—Fusion of centers of calcification and union by tubular dentinal substance; calcific deposits within walls of arterioles. (×100.)

by the width of the area of predentin, which, when calcification is normal, is in proportion to the activity of the odontoblasts.

5. The pulps of teeth sustain injuries from the indiscriminate use of silicate cements, which may be prevented by proper protection of the pulp.

6. Calcification within the pulp arises from three different sources, the resultant

Fig. 20.—Large area of calcification within pulp and its attachment to dentin wall. (×30.)

types being morphologically recognizable:

(*a*) Metabolic disturbances such as vitamin deficiency and the resultant infolding of the odontoblastic layer to form islands of dentin.

(*b*) Calcification subsequent to and associated with hyalinization of connective tissue.

(*c*) Calcification of amyloid bodies.

7. Calcification of the pulp is usually associated with connective tissue which, in the pulp, is largely perivascular and perineural. Aside from this anatomic relationship, there is no evidence that calcification *per se* interferes with the blood supply to the pulp or with the nerves, to cause neuralgia.

The more common calcification of the pulp follows in the wake of degenerative processes. It might be possible that the etiologic agent which was responsible for the degenerative processes preceding calcification is independently the cause of the neuralgia which is sometimes relieved by the removal of teeth. Since calcification of the pulp cannot be established as the cause for facial neuralgia and the degenerative processes which precede this condition are not roentgenographically demonstrable, it is evident that roentgenograms of the pulps are of little value in establishing the cause of obscure facial neuralgia.

HEREDITY AND TRANSMISSION*

By PARKE H. SIMER, Chicago, Ill.

IT is a fundamental conception that all matter is divisible into two types, the living and the nonliving. Although an entirely satisfactory explanation of the origin of living things is lacking, biologists are agreed that the plants, animals and intermediate forms which compose this group possess certain fundamental properties which do not exist in nonliving material. One of the most important properties of living forms is their ability to reproduce, and as a result we see a continuous succession of new generations.

In the one-celled plants and animals, the reproductive activity is often asexual, that is, multiplication by binary fission and budding, without the formation of special sex cells or gametes. In the more complex multicellular organisms, special reproductive organs are formed in which develop male sex cells, called sperms or microgametes, and female sex cells, called eggs or macrogametes. The union of a sperm and egg brings about a combination of cellular material of two different kinds, and results in the fertilization of the egg, then called a zygote. The formation of the fertilized egg cell, or zygote, marks the beginning of a new individual for, from this single cell, by repeated division and specialization, the tissues and organs of the offspring are formed.

It is a remarkable feature of this reproductive activity that the offspring tend to resemble their parents. Everyone recognizes that the corn seed when planted always produces a corn plant, never a vine or tree. It is no less certain that the mating of rabbits will always produce offspring of the same species—not animals of another kind. In the human race, the tendency for children to resemble their parents or more distant relatives is of general knowledge. The resemblance among individuals related by descent is called heredity, and those individual

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characteristics which appear to run in families are spoken of as hereditary. It is important to bear in mind that the maternal and paternal sex cells are the only physical elements passed on from one generation to the next, and that explanations of heredity must consequently involve a careful study of the structure of these units which form such a minute but efficient bridge between succeeding generations.

Although the resemblance between offspring and parents is often remarkably close, it is true that among these same offspring there are striking differences. These differences are spoken of as variations, and it is a fundamental principle that they exist in all living material. Since the sex cells are the physical basis of heredity, we may explain some variations by assuming that the sperms and eggs produced by a given set of parents are not alike in content. Such variations in offspring may result from the recombination of traits that have been parceled out in the formation of germ cells. There are other variations that are the result of such environmental factors as heat, light, food and altitude. It is evident, therefore, that every individual of a species is the result of the expression of two kinds of factors, hereditary and environmental.

Genetics is the name given to that science which attempts to discover and apply the laws of inheritance. It involves the study of heredity and variation, and seeks to explain the mechanism of transmission of characters from parents to offspring. Genetics is the youngest of the several branches of biologic science, although many of the fundamental conceptions upon which this study is based are centuries old, having been handed down from the herdsmen and animal breeders of early times. Their observations and explanations of results obtained in various types of crosses, which are recorded in the natural history of Greek and Roman literature, constitute the earliest written records in the field of genetics.

The invention and perfection of the microscope opened a new field of investigation to those interested in heredity. Near the end of the seventeenth century, the animal sperm was first observed, and, a few years later, its function in fertilization was explained. The discovery of the process of fertilization in plants marked the beginning of intensive experimentation in plant hybridization by means of artificial pollination, thus introducing the experimental method into this science. These investigations continued throughout the eighteenth century, culminating in the contributions of Gregor Mendel,[1] published in 1865.

Mendel, a monk in the Augustinian monastery at Brünn, Austria, was intensely interested in plant breeding. Unlike those who preceded him and many of his own time, he possessed keenness of observation, clarity of reasoning and, above all, a desire to keep complete and accurate pedigree records. He was assisted in his study by an extremely fortunate choice of experimental material, and by his selection of contrasting characters for investigation. Because of his intellectual endowments and good fortune, he was able to discover natural laws which had remained hidden from other plant hybridizers, and which formed the foundation for much of our present knowledge of inheritance. It seems almost unbelievable at the present time that findings of such importance did not receive immediate recognition, but one must remember that Mendel's report was published in an obscure Austrian journal, and that only a few years before had Darwin given to the world his monu-

1. Mendel, Gregor: Versuche über Pflanzen Hybriden. Verh. Naturf. Verein in Brünn, Vol. 4, 1865.

mental work on the origin of species. It was not until 1900, when the controversies resulting from Darwin's book had partially abated, that three investigators independently unearthed Mendel's work and presented it to the scientific world. Since that time, his experiments have been repeated again and again, and his findings have always been substantiated. This is ample proof of the accuracy of Mendel's methods and the soundness of his reasoning.

A simple experiment in plant hybridization will serve to illustrate these methods. If a pure red-flowered pea is crossed with a pure white-flowered plant of the same species, the seeds resulting from this cross will produce plants which are all red-flowered. The absence of white flowers might suggest that this characteristic has been destroyed in the cross, but the fallacy of this supposition is proved by a study of the second hybrid generation. When the red-flowered plants of the first hybrid generation are inbred, the resulting seeds produce both white and red-flowered plants. Following Mendel's technic of counting all offspring showing contrasting characteristics, we find that approximately three fourths of the second hybrid generation are red-flowered, and one fourth are white-flowered, the now famous 3:1 ratio.

How may these results be explained? We may say that one of the original parents was red-flowered because it carried within the cells of its body hereditary units, called genes, for redness. The sex cells of this parent likewise contained these genes. The other parent was white-flowered because its soma cells lacked the genes for redness, as did also its sex cells. The fertilized egg cell, being a combination of the two types of sex cells, produced a red-flowered plant, each body cell of which contained two distinct genes for color. Since all flowers of the first hybrid generation were red, it is evident that the gene producing redness completely dominated the gene causing lack of color. Whenever two contrasting traits in parents express themselves in this manner in the offspring, the factor which appears in the first hybrid generation is said to be dominant, and the one which is hidden is recessive. The sex cells formed in the first hybrid generation must be of two kinds, some containing the gene for red flowers and others without it; for the white-flowered plants of the second hybrid generation evidently result from the union of two sex cells, neither of which contains the gene for red flowers. If the correctness of this hypothesis is assumed, it becomes apparent that the genes are distributed in the production of germ cells, and reassembled in the formation of zygotes, but do not lose their identity, even though their activity may be temporarily hidden in some generations. This was Mendel's conclusion. Its correctness is emphasized by breeding experiments with plants of the second hybrid generation. If self pollination is practiced in the red-flowered plants, approximately one third of them breed true, that is, produce only the red-flowered type, in all future generations. According to our explanation, these plants must have developed from the union of sex cells which contained color genes for red flowers only. All of the remaining red-flowered plants of the second hybrid generation produce both red and white-flowered offspring. Again, if we apply the principle of segregation and recombination of genes, it appears that these parents were the result of the union of two types of sex cells, one containing the gene producing red flowers, and the other lacking this gene. The white-flowered plants of the second hybrid generation breed true in future generations; which substantiates the orig-

inal supposition that they contained no gene for flower color.

In his investigations, Mendel considered seven pairs of contrasting characteristics, and it so happened that in those selected, dominance was always present. Consequently, when contrasting pairs were brought together in a cross, members of the first hybrid generation were all alike and showed only the dominant characteristic. In their offspring, the grandparental characteristics appeared and were sorted out in definite fashion. Later investigators discovered that complete dominance is not nearly so common as one might suppose from Mendel's results. It now appears that in crosses between parents having contrasting characteristics, the offspring are more likely to be intermediate with reference to the contrasting character, rather than exactly like one of the parents. This is illustrated by the results obtained in crosses between pure black and splashed-white fowls. In such a cross, the members of the first hybrid generation are an intermediate color, a shade of blue. While it is evident that such breeding results do not in any way modify our conception of segregation and recombination of genes, they do indicate that there is a wide range of possibility in the manner in which genes of various types may react to each other, and help to explain the appearance of many variations.

The decade following the discovery of Mendel's work was an especially active one in genetic research. One distinct advance was the introduction of the small fruit fly, Drosophila, as a laboratory animal. Investigators were now able to secure several generations of offspring in a relatively short period of time, and many interesting discoveries were made. Perhaps the most important result was the formulation of the chromosome theory of inheritance, based on detailed cell studies. It provided cytologic proof of the correctness of Mendel's hypothesis of segregation and recombination of genes, and it helped to explain many breeding results which had not been understood.

The microscope had revealed that all living things are composed of cells. Further study had shown that cells contain nuclei, within which are darkly staining bodies called chromosomes. Every somatic cell of a plant or animal was found to contain an even number of chromosomes, constant in that species. More detailed examination showed that, regardless of their number, the chromosomes could always be grouped in pairs, on the basis of their general size and shape, and often the members of a pair were closely associated. In ordinary mitosis, resulting in the division of a parent cell into two daughter cells, each chromosome splits longitudinally into two equal parts. Each daughter cell receives one half of every parent chromosome, and thus the number remains constant in all somatic cells. Microscopic examination shows that cells which form gametes possess the same number of chromosomes as do the other cells of the body. When the gamete producing cells commence to divide, the chromosomes behave in a peculiar manner. No chromosome splitting occurs as in ordinary mitosis. Instead, one member of each chromosome pair passes bodily into each new cell and becomes organized into the nucleus. It is evident that the resulting sex cells possess only one-half as many chromosomes as do the somatic cells, and it is only when two sex cells unite to form a zygote that the normal chromosome number for the species is again obtained.

These facts might suggest that the chromosomes are in reality genes, but that idea is discredited by the simple fact that there are many more genes than there are chromosomes. In Drosophila, for ex-

ample, the normal chromosome number is four, yet the presence of more than fifty genes has been definitely established. All available evidence leads to the conclusion that the genes are located in the chromosomes, and that their segregation is the result of the distribution of the chromosomes in the formation of sex cells. This is the essence of the chromosome theory of inheritance, as suggested by Morgan. Its application satisfactorily explains the results obtained in the experiment in hybridization of peas, previously described. Microscopic study shows that the normal chromosome number for this species is fourteen, forming seven synaptic pairs. One pair must contain the genes for color, and since one parent was pure for red flowers, a color-producing gene is present in each member of that pair. We may therefore represent the genetic constitution of this parent by the symbol RR. Since each sex cell receives only one member of each chromosome pair, all such cells of this parent will contain seven chromosomes, one of which contains the gene R. The white-flowered parent lacks the color-producing gene in its corresponding chromosome pair, and may therefore be designated rr. All sex cells of this parent lack the gene for flower color, and may be represented by r. As a result of fertilization, all zygotes and resulting soma cells of the first hybrid generation have fourteen chromosomes, the normal number for the species, and their genetic constitution with reference to flower color may be represented as Rr. We have already seen that all plants of this generation are red, as would be expected in a case of pure dominance. It is apparent that the sex cells of the first hybrid generation will be of two kinds, some containing the gene R, others the gene r. The combinations possible in zygote formation are RR, Rr, rR and rr. Since pure dominance exists, we would expect three fourths of the second hybrid generation to be red, and one fourth white, the exact ratios obtained in the breeding experiment.

In his study of the results of experiments in which plants differing in two or more contrasting characters were crossed, Mendel discovered the principle of independent assortment of genes. He found that the relation of each pair of different characters in hybrid union is independent of the other differences in the two original parental stocks. If a pea plant with yellow, round seeds was crossed with one bearing seeds which where green and wrinkled, all seeds of the first hybrid generation were yellow and round. This of course is another example of pure dominance. In the second hybrid generation, many plants appeared whose seeds were unlike those produced by either of the original parents. In nine-sixteenths of the plants, the seeds were yellow and round; in three-sixteenths, yellow and wrinkled; in three-sixteenths, green and round, and in one-sixteenth, green and wrinkled.

We can again resort to the chromosome theory of inheritance to explain these results. Assuming that the genes for the two contrasting characters are located in different chromosome pairs, the parent producing yellow, round seeds may be designated YYRR. The other parent will then be identified by the symbol yyrr. The sex cells will be YR and yr, and the genetic constitution of the first hybrid generation with respect to these two characters will be represented by the letters YyRr. Since pure dominance exists, all seeds in this generation will be yellow and round, as has already been determined by breeding experiments. In the formation of sex cells in the plants of this generation, the possible assortments of these two pairs of chromosomes are as fol-

lows: YR, Yr, yR and yr. The offspring resulting from the chance combinations of these sex cells will be of four types as follows: nine-sixteenths will produce yellow, round seeds; three-sixteenths, yellow wrinkled ones; three-sixteenths, seeds which are green and round, and the remaining one-sixteenth, seeds which are green and wrinkled. Since these are the same seed types and the same ratios secured in the breeding experiments, it is evident that the chromosome theory satisfactorily explains the experimental results.

In view of the fact that there are fourteen chromosomes in each body cell of the pea plant, it is apparent that many different assortments are possible in the formation of sex cells in the first hybrid generation. The exact number is 128, as expressed by the formula 2^n, in which n represents the number of chromosome pairs. Since each chromosome is composed of many genes, it is evident that those in any one chromosome will be distributed as a group in the process of segregation; consequently, the characters which they produce will show a tendency to occur together. This phenomenon is called linkage. It has also been discovered that the members of a chromosome pair sometimes break transversely, and a segment of one chromosome unites with a portion of the other. In this way, genes of one chromosome become associated with those of its synaptic mate, a condition spoken of as crossing over resulting. The principles of normal distribution, linkage, crossing over and interaction of factors are all necessary to explain many of the unexpected results obtained in breeding experiments.

Having in mind the fundamentals of the machinery of heredity, we may now consider briefly the question of environment. It has been stated previously in this discussion that the individual is influenced by both hereditary and environmental conditions. The importance of the environmental conditions has often been underestimated, but one needs only consider a few of the variations resulting from lack of food, improper diet, extremes in temperature, absence of proper light and abnormally high altitudes to reach the conclusion that environment is extremely important. More than a century ago, Lamarck was led to conclude that the variations in parents resulting from environmental influences were transmitted to their offspring, and he originated the theory of the transmission of acquired characteristics. No theory in the field of genetics has attracted more attention or has been subjected to so many rigid tests. It has been found that mutilation, such as cutting off the tails of adult white rats, never affects the offspring, regardless of the number of generations the experiment is continued. It is common knowledge that variations resulting from occupational activity, as the enlargement of the biceps of the blacksmith, are not inherited. As a result of these and numerous other experiments, most biologists have discarded Lamarck's theory, and are agreed that the only variations that can be transmitted to offspring are those which modify the character of the gene.

Geneticists believe that most, if not all, known genes have arisen by a process called "mutation," a sudden spontaneous, intrinsic change, in which a gene suddenly appears, disappears or changes in function. Such changes show no evident relationship to environmental influences. Numerous investigators have attempted to modify the germ cells experimentally, and thus produce artificial mutations. Stockard,[2] by administering alcohol to

2. Stockard, C. R., and Papanicolaou, G.: Effect of Alcohol on Treated Guinea Pigs and Their Descendants, J. Exper. Zool., 26:119-226 (May) 1918.

guinea-pigs, obtained many embryos and young which showed numerous types of defects. He interpreted these variations as due to direct injury to the germ cells by alcohol. They reappeared in the unalcoholized offspring of defective animals, showing that such injuries may persist for more than one generation. Guyer caused fowls to develop antibodies against the lens tissue of rabbits' eyes, by repeatedly injecting them with the pulped material from young rabbit lenses. The blood of fowls containing lens antibodies was then injected into pregnant rabbits. Among the offspring of mothers so treated, several young were found which showed various defects of the eye and lens. These defects proved to be inherited, both when the defective-eyed rabbits were bred to their own relatives and when they were crossed to unrelated, normal-eyed rabbits.

Guyer believes that a new character has been produced which acts as a mendelian recessive. Others explain the results in a different way, and refuse to accept the conclusions of these investigators. On the basis of all available data, it is safe to conclude that the inheritability of few if any of the variations which are ordinarily spoken of as environmental has been definitely established. This means that plant, animal or human improvement cannot proceed solely or permanently merely by improving the environment of the organism. The same may be said of modifications which affect the appearance or functions of the individual without altering its germ cells. On the contrary, improvement must come from changes in, and recombination of, the chromosomes themselves.

We must now consider the subject of heredity in man, and discover the possible applications of its laws in the field of orthodontia. Attention has already been called to the fact that characteristics of parents reappear in their offspring, and that the offspring show variations from each other and from their parents. All available evidence points to the conclusion that the inheritance of characters in man follows the same principles that we have just outlined, and the same may be said with reference to inheritable variations. The importance of new combinations of chromosomes should be emphasized. In man, the normal chromosome number of forty-eight permits the formation of millions of sex cells (2^{24}) which are genetically different, and the number of possible combinations in zygote formation is almost unbelievable (3^{24}). Doubtless, most of the inherited variations which appear in the human race are due to the segregation or recombination of traits, the genes for which have been present in the parents.

The problems of human inheritance cannot be studied by the methods employed with plants and animals. Direct experiments are, of course, impossible, and data must be accumulated by the less exact method of analyzing family histories and pedigrees. The study of human inheritance from the scientific point of view may be said to have begun in the last half of the nineteenth century, with the work of Frances Galton.[3] His studies, summarized in a notable book, "Hereditary Genius," mark the beginning of the investigation of both mental and physical traits in man.

Other investigators have continued these studies, and we now have an imposing list of traits that are known to be inherited. We know, for instance, that "dark" eyes are dominant over blue eyes, and the differences between them is probably due to a single factor. Brachydactylia, a condition in which the hands and feet are short and stubby, and in which

3. Galton, F.: Hereditary Genius, London: The Macmillan Company, 1869.

the arms and legs are usually shorter than normal, is also apparently due to a single mendelian factor. Zygodactylia, the fusion or "webbing" of adjacent fingers and toes, and polydactylia, the presence of extra fingers and toes, are known to be inherited and are ordinarily dominant over the normal condition. Hereditary deaf-mutism seems to act as a recessive. Many other traits are apparently due to a single medelian factor, either dominant or recessive, but their expression is either so complicated by modifying factors, or the knowledge of them is so limited, that they cannot at the present time be definitely placed in this group. The most conspicuous of the sex-linked traits, which are traceable to genes located in the sex chromosome, is color-blindness, especially the red-green type. Hemophilia, or tendency to abnormal bleeding, Gowers' disease and night-blindness also appear to be sex linked. In a recent book on human heredity, Lenz discusses these and many other inheritable traits, and presents important data which anyone interested in this field should consult.

There are numerous references in the literature to anomalies in tooth and jaw formation which are apparently inherited, but only a few of the more recent ones will be mentioned here. Hrdlička[4] (1922) concluded that such anomalies are the result of phylogenetic tendencies, inherited nonevolutionary conditions and individual acquisitions; while McClain[5] (1925) stated that inheritance has little to do with deformities such as malocclusion. Many other orthodontists feel that heredity plays an important part in the etiology of this anomaly, as indicated by the contributions of Sippy[6] (1926), and Chapman[7] (1926, 1927). A beginning in the scientific approach to this subject by the study of family histories has been made by Thadani[8] (1921), Fürst[9] (1925), Thomas[10] (1926), Beadle[11] (1926) and Huskins[12] (1930), all of whom described certain dental anomalies which are present in several generations of a family. Progenia, lower jaw prognathism, has been said to have a dominant heredity, as seen in the Hapsburg family. Recent studies of twins indicate that anomalies in the position of teeth are, for the most part, hereditarily determined. Moreover, Weitz[13] (1924) has observed that in monovial twins even caries tends to affect exactly the same teeth. Important as these observations are, it must be admitted that conclusive proof of the hereditary nature of most dental anomalies is lacking. For the present, therefore, this must remain an open question.

The answer to this and related ques-

4. Hrdlička, Aleš: Causes of Malocclusion, D. Cosmos, 64:489 (May) 1922.

5. McClain, H. W.: Some Deformities of Jaws, Chicago D. Soc. Bull., 5:8-12 (Feb. 20) 1925.

6. Sippy, B. O.: Prevention of Malocclusion, Chicago D. Soc. Bull., 6:17-19 (Nov. 20) 1925.

7. Chapman, Harold: Orthodontics: Necessity of Histories to Establish Etiology; Necessity of Extra Function in Retention; Necessity of Preserving Spaces Caused by Premature Loss of Deciduous Teeth, D. Rec., 46:672-676 (Dec.) 1926.

8. Thadani, K. I.: Toothless Type of Man; Bhudas of India; a Case of Sex-Linked Inheritance, J. Heredity, 12:87-88 (Feb.) 1921.

9. Fürst, T.: Der Erbgang bei Anodontie, Arch. für Rassenbiol., 16:310-311, No. 3, 1925.

10. Thomas, L. C.: Five Studies in Human Heredity, Eugenical News, 11:150-159 (Oct.) 1926.

11. Beadle, O. A.: An Inherited Anomaly of Dentition, J. Genetics, 17:199-206 (Oct.) 1926.

12. Huskins, C. L.: Inheritance of Anomaly of Human Dentition, J. Heredity, 21:279-281 (June) 1930.

13. Weitz, W.: Über die Bedeutung der Erbmasse für das Gebiss nach Untersuchungen an eineiigen Zwillingen, Deutsche Monat. f. Zahnheilk., 42:89-93, No. 5, 1924.

tions must of necessity come from the orthodontist. He alone has the technical knowledge necessary for complete and accurate examinations. If he is equally accurate and systematic in recording the results of his findings, and in cooperating with his co-workers of this and future generations, the relation of heredity to the etiology of dental anomalies will be ultimately established.

APPLIED PSYCHOLOGY IN FULL DENTURE PROSTHESIS*

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IT is not the intent of this paper to give a learned discourse on psychology any more than it is intended to present a technic for denture construction. By using the analysis that trained psychologists have made of human emotions and actions, I hope to point out how even a casual or superficial knowledge of certain phases of psychology may be of great benefit to the prosthetist. What prompted the writing of this paper was the oft-heard remark about psychology in dentistry. For example, I have heard dentists tell of the psychologic effect on patients of certain incidents in the office, and I have heard other dentists tell of the manner in which they used psychology in presenting a proposition to their patients. You have heard such remarks and no doubt have made similar ones yourself. We constantly hear of the psychology of advertising, of salesmanship, of healing, and so on, including practically every type of business and professional experience. Through all of these experiences, we should be aware of the fact that much that is not psychology masquerades as the real thing.

Among dentists and patients the belief is frequently expressed that a certain dentist has difficulty with his patients because of his personality, notwithstanding all agree that he is a skilful workman. The fact probably is, in dentistry at least, that what we choose to term psychology actually is the projection of our personality into our dealings with patients. This may be termed an unconscious or untrained psychology and the difference in results among dentists represents a difference in personality.

Alexander Pope once said, "The proper study of mankind is man." On the face of it, this seems a commonplace thing to say, but the more we study his thought, the more significant it becomes. The psychologist brings out the thought that every man is a salesman, that is he has the ability to sell. He may sell his ability directly to an employer or he may sell the goods his ability has produced, but he must sell and buy as long as he remains a part of any civilized community. Applying this thought to dentistry, I think the word "sell" should be interpreted to mean the ability to convince a patient that we as trained and experienced dentists know what plan of restoration is best and that we have the ability to assure that type of restoration in a high degree of excellence. If any dentist has the feeling that his personality approach

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is below par, I suggest that he study psychology diligently and from such a study incorporate certain selected findings in his daily contacts with people. The man who has a pleasing, or what we might call a successful, type of personality, can make even better use of his talents by proper organization of his thoughts after a study of psychology.

It should be borne in mind that in this discussion of the application of psychology, we are striving toward better service to the patient. I stress this point for the reason that much of the conscious or unconscious psychology practiced by dentists may be an attempt to cover up faulty workmanship and, by sheer force of personality, convince the patient that the work is really well done. Again, the dentist may be trying to persuade the patient that a higher fee level is justified. These two types of psychology are not the kind we are to consider.

We should determine a correct basis or starting point for this discussion, and, in my opinion, this should be a thorough knowledge of the principles of denture construction. We might suggest that such a knowledge takes into consideration a clear understanding of the physical condition of the patient and the relation of mouth conditions to general health. We should be concerned as to what can be done to make the patient comfortable and to give him masticating efficiency, and as to how we can benefit related structures and improve the appearance, accomplishing all of this in the shortest possible time and with the least discomfort. Possessing the necessary skill to successfully produce what our understanding of the case indicates that the patient should have, we are justified in studying the principles of psychology in an effort to discover whether there are methods that we can use to help the patient mentally.

Psychology is defined as "the science of the phenomena of mind." It is thus set off from the physical sciences, which teach the phenomena of matter.

James has this to say:

> We have a lot of beginnings of knowledge made in different places and kept separate from each other merely for practical convenience sake. These provisional beginnings of learning we call the sciences. In order not to be unwieldy, every science has to stick to its own arbitrary selected problems and to ignore all others. Mechanical science assumes that matter has mass and that it exerts force. Motion is assumed by mechanical science to exist independently of the mind in spite of the difficulty involved in the assumption. Physics assumes atoms; chemistry uncritically adopts all data of physics; and physiology adopts those of chemistry. Psychology as a natural science deals with things in the same partial and provisional way.

Psychology is also defined as the science of individual experience. Here may be a definition that points the way for the application of psychology to our field. When a patient decides to have dentures, his past experience is of paramount importance to his dentist. Was the past experience with natural teeth, and, if so, how much trouble did he have with them? Does he feel that, because of having a great deal of trouble with his own teeth, his troubles will be entirely over with the new denture, or does he come with a memory of satisfaction with his own teeth and expect the teeth that the dentist makes for him to be equally comfortable and efficient? Innumerable combinations under the heading of individual experience could be cited which influence mental attitude and therefore are properly in the field of the definition of psychology.

We all use daily some of the principles of psychology, often without knowing what they are. The boy who leaves his jackknife on the back doorstep over night and finds it rusted in the morning

might, if he knew something of the principles of chemistry, save his knife from rust; and so may we, with a knowledge of some of the essentials of psychology, do better denture work for our patients. I shall set forth a few definite expositions from the field of pure psychology and attempt to make an application of each to denture construction.

PERCEPTION

Psychology teaches that perception is the mental process by means of which we select such sensations as we wish to make the basis of our conscious life. Perception enriches sensation by adding to it all of the remembered past and is the recognition of the cause of sensation. The value of anything we perceive then depends on how rich a past relates to it. For example, school children in southern California have great difficulty in perceiving the significance of Whittier's poem, "Snowbound." The perception concerning home life is different in Zululand from what it is on Park Avenue, New York. Therefore, every new sensation should be closely scrutinized in order to determine whether it can be related to some group of ideas already in mind.

There is in the field of denture work rich food for thought in this idea concerning perception. Dr. House and others have from time to time set up fact-finding charts to be used by the prosthetist in order to have available tangible evidence of the patient's mental attitude in general and with special reference to artificial dentures. I would head such a chart with the word "perception," and under that heading would attempt to follow the psychologist's plan and obtain from the patient as broad an understanding as possible of his perceptions relating to artificial dentures. We should know as much as possible of his past experience with teeth, whether they be natural teeth recently lost or dentures that he has been wearing and what he expects from the new ones. The big point which the psychologist emphasizes under perception is that all new sensations are colored by past experience. Therefore, if the patient's past experience has been a happy one, the prosthetist's job becomes increasingly difficult, especially if it seems desirable to make changes in jaw relationship. But having knowledge of the patient's past experience, we should be able to influence his mental attitude in the new experience with which he is now confronted, whether it be a difficult one or one easy to face. Many a case has been a disappointment to both patient and dentist because this detail was not given sufficient consideration when the case was started.

Under "perception," there are related headings, such as: to imagine; to remember; to expect. I call attention to these three, for, it seems to me, they epitomize the whole matter of perception in our field. We know that our patient remembers many things that we wish him to remember and many things that we wish him to forget. We know that he imagines many things that we wish could be changed. We know that he expects certain things, and if we know what they are, and we should know, it is our task to fulfil those expectations if possible. But if his expectations are impossible to attain, we should go about changing his mental attitude to the point where he understands what he may reasonably expect.

SENSATION AND MOVEMENT

The denture prosthetist is constantly confronted with the problem of jaw movement, and where orthomorphia is a part of the reconstruction scheme, we can expect some concomitant sensation of pain or discomfort for an indefinite pe-

riod. The only psychologic evidence that we have of any connection between sensory and motor representations is that furnished by acquired dexterity, i. e., by such movement as the psychologist Hartley styles secondarily automatic. Broadly speaking, we find the sequence of the sensation movement is as follows: 1. We are aware of certain changes in our sensations, thoughts or circumstances. 2. We are pleased or pained with the change. 3. We act accordingly.

Sensations are not knowledge any more than cotton is cloth. They are the raw materials out of which knowledge may be built. My interpretation of the psychologist's observations in the field of sensation and movement as related to denture prosthesis is that we must look to the occlusion of our cases for the meaning of most of the reactions of the patient. What has been termed the tactile sense of cusp contact is probably even more important than we have thought it to be. I am convinced that unless we can find the mandibular movement path and build the case to conform closely to it, the sensations of the patient will be such that he does not execute the true movement with the new dentures in place. The so-called grinding-in after the case is complete is, of course, helpful; but unless the patient's own peculiar movement path has been incorporated, it is almost impossible to "grind in" a case to the highest efficiency.

We should be able to place in the patient's mouth dentures that will give him the sensation of a better anatomic relationship, so that he will be pleased with the position no matter how he bites and he will act accordingly, giving us his true mandibular movement. I know of no instrument *per se* that will give us the definite movement path of every patient or even reproduce it, but there are combinations of technics that will produce that path. Whatever changes we may think it necessary to incorporate regarding jaw relationship must synchronize with the patient's own peculiar movement path or his sensations and resultant actions will not be in accord with the plans originally made for the case. A dentist should know what the sequence of sensation and movement and adjustment will be in each case and, in addition, should know how much volition or will power the patient must develop in order to quickly and properly train the muscles for the new positions.

POWERS OF ATTENTION

The human powers of attention are so limited that we cannot alter the distribution of attention at any moment without altering the contents of consciousness at that moment. Consequently, we need to be careful, when we present the various problems connected with a denture restoration, that we do not confuse the patient's mind with several divergent thoughts. We all remember the experience in constructing cases, after what we considered a thorough understanding with the patient, of finding, before all adjustments have taken place, that the patient has had an entirely different idea of what to expect from that we thought we had given him. Psychology teaches that, in such cases, the psychologic observer, who now is the dentist, must learn to take momentary glances at the psychologic aspects of the phase of consciousness in question. This I take to mean that we must learn to group our thoughts and present all in one group without mixing in thoughts or ideas not closely related. For example, if under perception we have found that the thing the patient is most interested in is comfort, although the dentist may see many other things that are necessary, he should carefully group every idea that

he has about making the new denture comfortable before going on to the other points. Another patient may be most interested in appearance, another in function, and so on. Cases have been lost or patients and dentists disappointed because the dentist did not familiarize himself as to the patient's principal idea concerning new dentures. The patient must be analyzed mentally to determine how many of these groups may be presented at any one time. I am not so sure but that it may prove to be the better plan to write out briefly and give to the patient the ideas that we wish him to have to carry him through the adjustment period of a new set of dentures. Such a grouping of thoughts about each case might be termed a mental attitude guidance chart and may be worth while considering.

The question may be raised in the minds of many of you as to whether I am unduly alarmed over the ability of a majority of dentists properly to carry on denture cases, or I advocate too strongly the radical type of anatomic change between mandible and maxilla. I have neither of these thoughts in mind, the only reason for stressing these points being to emphasize some of the values in the observations of the psychologist. I am convinced that true psychology can be very helpful if properly understood and properly used in any type of denture prosthesis.

462 Lowry Medical Arts Building.

RÉSUMÉ OF LOCAL ANESTHESIA IN DENTISTRY*

By THEODOR BLUM, D.D.S., M.D., Universae Medicinae Doctor (Vienna), F.A.C.D., F.A.C.S., New York City

IT has been said before, but it bears repeating, that the advent of local anesthesia marked a great progressive step in dentistry, equal if not superior to Taggart's invention of the gold inlay. Many attempts have been made to discredit this excellent means of alleviating pain during dental and surgical operations by exaggerating the toxicity of the drugs employed and the difficulty of the methods, as well as the dangers from broken needles and the frequency of breakage and the spreading of infection by careless operators.

All this is continuously minimized by the steady advance of dental education and the teaching of local anesthesia to students and graduates. At any rate, the objections above mentioned were never important factors in an argument against the employment of the method. Attempts, based apparently on personal interests, have been made recently to induce dentists to employ general anesthesia in preference to local. There is no logical mind that could see any unselfish reason for such endeavors. Who should use general anesthesia? The general practitioner? Certainly not for operative dentistry and surely not for surgery for which he has neither the experience, the equipment nor the assistance. Therefore, it is the specialist only, the exodontist or oral surgeon, who would want to employ general anesthesia, and there unquestionably are occasions and indications

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for its use; but since I have never seen a general anesthetic employed in any office under the rules of asepsis, I feel that general anesthesia should be used only when absolutely necessary and indicated.

To return to the subject, I must say that, during my experience with local anesthesia, extending over more than twenty years, few changes or improvements have taken place. The same drugs, the same solution, the same mode of preparing the solution and the same type of needles are employed, and there are practically no changes in the technic. Therefore, the few points mentioned later on will be of only minor importance. While the experiments and research conducted in the last few years have been crowned with little success and have not been marked by appreciable advancement in this field, I believe that they should not only be continued, but also encouraged.

Fig. 1.—Osteomyelitis of right mandible.

Fig. 2.—Osteomyelitis of left mandible.

Since first employing local anesthesia, I have been using one drug; namely, novocaine, now called procaine. Many new anesthetics were heralded as superior to this drug, but not a one could take its place. A physiologic sodium chloride solution made up the vehicle and is still used in my work. Ringer solution was suggested many years ago, but it seems to me that the small amount of solution injected at one time makes such an exact duplication of the chemical make-up of the body fluids unnecessary. I still recommend tablets containing 0.02 gm. of procaine and 0.0005 gm. of suprarenin (epinephrine), each one dissolved in 1 c.c. of physiologic sodium chloride solution and prepared in the usual manner with a dissolving cup; a method which has been described so many times previously.[1] Such a 2 per cent solution is employed in all cases except cardiac, in which most of the specialists wish to have the amount of epinephrine reduced, this being accomplished by dissolving 1 tablet in 2 c.c. of physiologic sodium chloride solution. Only rarely does a cardiologist ask for the entire elimination of epinephrine, in which event the anesthesia is not so effective. For the extraction of a tooth by local infiltration, 2 c.c. is injected, the same amount for the mental, infra-orbital and tuberosity injections, while for the mandibular, 3 c.c. is used.

For a number of years, we have preferred the all-glass syringe to which the

1. A bibliography of articles on local anesthesia can be found appended. Blum, Theodor: Two Decades of Local Anesthesia for Dental and Oral Surgical Operations (1910-1930), Oral Health, 21:491 (Dec.) 1931.

needle is attached by a slipjoint. The syringe can be boiled very readily without breaking and the needles are of rustless steel. The heavy one for mandibular injections is 0.9 mm. thick and 40 mm. long; the thin one, used for all other injections, is 0.45 mm. thick and 42 mm. long. For the above-mentioned injections, the ordinary short hub and straight needle are entirely satisfactory. It is always well, whenever possible, to use instruments, syringes and needles which form one straight line, that the tip or point may be easily located when covered by tissues.

Although I have always preferred conduction anesthesia in both maxilla

Fig. 3.—Left mandible of patient (H. K.).

and mandible, we have found that local infiltration has a very important place in all simple operations such as extractions. In a region where more than one conduction injection would be necessary, we inject locally. If there is a small inflamed area, local circumscribed infiltration is employed, when the solution is deposited outside the inflamed tissue.

There is probably less indication for a mental injection than any of the other conduction methods and the mandibular is most frequently employed. It seems unnecessary to describe the technic in detail. The anatomic make-up of the region where we inject for mandibular anesthesia forces us to approach the internal oblique line from an anterior direction and at a point 1 cm. above the occlusal surfaces of the mandibular teeth. The syringe never crosses the median line between the two incisors. Failure is due in most instances to neglect of the foregoing and to the fact that the needle point is introduced beyond the mandibular nerve. In my experience, a vast majority of accidents were due to the use of a thin steel or an iridioplatinum needle, which, in so many instances, is sterilized by passage through a flame instead of by immersion in boiling water. Faulty technic, etc., as a cause of accidents has been previously described.

Most beginners blame anatomic anomalies for their failures with conduction anesthesia and even older practitioners are at times inclined to do so. For the beginner, surely it is a poor assumption, since he will not strive to improve his methods and technic. As a matter of fact, I would state that the presence of anatomic anomalies, as well as idiosyncrasies of one sort or another to the action of drugs, are so extremely rare that it is safest never to blame anything but faulty technic for lack of anesthesia. In my experience, I can recall only one case and probably one ill chosen, wherein a disease condition may have been the cause of failure. I am referring to the case of C.M.A., a man, aged 40, who, during January, 1915, suffered from a chronic osteomyelitis extending practically over the entire mandible. (Figs. 1-2.) The right side was operated on at the office under mandibular injection. The second operation, on the left mandible, could not be performed at the office because the mandibular injection did not take effect, and the patient had to be taken to the hospital and operated on under a general anesthetic. A study of

these roentgenograms may permit one to argue the possibility of a change of the anatomic make-up of the region injected. A positive assertion cannot be made even in this case.

Another case, as interesting, if not more so, is that of H. K., a man, aged 59, who came to my office in March, 1918, for the removal of a mandibular second molar. March 29, 1918, after premedication with two tablets of bromural, a mandibular modified technic produced numbness in the tongue only (?). A local infiltration of 1 c.c. each time, lingual and buccal, gave no resulting anesthesia, but some pain (partial anesthesia). Two roots of the lower left second molar were removed separately, with light curetment (not much thickened membrane), followed by iodine, anesthesin and iodoform gauze dressing.

It so happens that I have had the occasion recently to remove for the same patient (June 8, 1933) the lower right cuspid and lower left lateral incisor, cuspid and first bicuspid, for which I made a mandibular injection of 3 c.c. of a 1 per cent solution (cardiac case) made up by dissolving one tablet in 2 c.c. of physiologic sodium chloride solution. There was additional infiltration given lingually and buccally in the region of the first three teeth in question. All the teeth on the left side were removed without any sensation, while there was considerable pain when the right tooth was extracted. While I could have assumed in 1918 that the failure to produce anesthesia was due to the presence of anatomic anomalies, it is definitely proved from our recent experience that it must have been due to faulty technic. The fact that there was pain after infiltration on the right side only shows that that type of injection is not so effective in the mandible, particularly in a patient 74 years of age. Figure 3 illustrates the anatomic make-up of this patient's left mandible when the mandibular injections were given in 1918 and 1933.

The only innovation of the infra-orbital injection is based on the anatomic position of the infra-orbital foramen, which was pointed out some years ago by Sicher of Vienna. We changed to this method because the technic is logical and just as simple as the old one.

There is no change as far as the tuberosity injection is concerned, but I do want to call attention to the importance of directing the needle at the point of insertion straight against the periosteum and then sliding it upward over the periosteum to the area where the solution is deposited for the purpose of avoiding injury of the alveolar vessels in this region through which quite frequently a hematoma develops.

We have never employed injections at the base of the skull at the office and very emphatically oppose such practice, particularly because I have never found an indication for their use there.

The question often arises as to whether it is proper to inject into inflamed tissue. It is true that such a procedure has been employed at times by general surgeons, and certainly more frequently by dentists and I daresay with varying effects. It seems to me that these are instances wherein a general anesthetic should be resorted to instead of a chance taken with uncertain results and dangerous effects.

Discussions regarding the removal of broken hypodermic needles have been rather frequent, but the subject is too often written about by practitioners with little experience. In one case, a dentist started a long controversy with another one about the ways and means and methods for the removal of such fragments, and it finally was disclosed that he had operated in only three such cases. This

is not the time nor place to go into detail as to the operative procedure for their removal. Suffice it to say that it should be accomplished by the practitioner experienced in this work because previous attempts naturally make removal so much more difficult and perhaps impossible even for the experienced operator.

Unfortunately, I have had no experience with accidents which are blamed on the use of either procaine or epinephrine. If the practitioner would pay a little more attention to the general condition of the patient and would insist that he consult a physician before beginning dental treatment, practically all such accidents could be avoided. I have written on this subject before, but it bears repeating. I would not only want the cooperation of the physician were I in general practice, as I do in my special work, but I also believe that every physician should insist on getting a report from the patient's dentist in every case. In this way, not only would accidents be avoided, but also early lesions would be detected at a time when our present limited knowledge of disease could be most helpful to our patients.

Although I have in the introduction of this paper deplored the attempt to popularize general anesthesia in dentistry as a routine method, I wish to repeat again that local anesthesia to the logical mind is so far superior for the average case in general as well as in special practice, it seems a pity that so much time and energy is wasted by those promoters of general anesthesia when it could be spent to much better advantage.

In previous years and while local anesthesia was not so generally employed by the general practitioner, I was called on many times to administer a local anesthetic for operative dental procedures, while in the last ten or fifteen years this has occurred only a few times each year, for which reason my experience with this form of anesthesia is confined mainly to surgical cases. Local anesthesia has in my practice turned out to be as advantageous and successful as anyone could possibly wish or expect.

As stated before, there are few improvements in anything that pertains to this subject. Whether you can get anesthesia in two minutes or in fifteen minutes never mattered the least at any time during these many years. I could enumerate a number of things to which some investigators have attached great importance, but, in spite of all this, we must never stop to observe and to experiment for the purpose of improving and increasing our knowledge so that, in the ultimate, our patients may reap the fruits of our endeavors and investigations.

101 East Seventy-Ninth Street.

CONSIDERATION OF THE NEWER DENTURE MATERIALS*

By WILLIAM DENTON TAYLOR, D.D.S., Newark, N. J.

IN considering the countless conveniences which we utilize daily, it is hard to realize that many of those that we have come to take for granted were, only a few years ago, classed by the majority of men as nothing but the wildest sort of day dreams. One does not have to be aged to recall the time when the horseless carriage was nothing more than a fantastic curiosity, an expensive and temperamental plaything; when the electric light was a novelty that only the wealthy could enjoy; when one of the greatest scientists of the day solemnly announced that man would never fly in heavier-than-air machines; when it was still something of an adventure to make a telephone call, and when the present-day denture was to you and me but one of those day dreams. These important common adjuncts of present-day life did not create themselves. Each of them represents long careful research on the part of American inventors, and none of them sprang full grown into the picture.

There was a time in history when new products or processes were discovered rather than invented. Men would stumble on them, surprising themselves probably as much as they did the world. But our scientists and technicians today are by no means groping about and hoping for some happy chance or sudden inspiration to reward their efforts. They set themselves very definite problems, and they work patiently along carefully calculated lines until they have arrived at definite and satisfactory solutions.[1]

Through efforts such as these have we come to see products developed which are probably destined to supplant, as a denture base material, the vulcanite of Goodyear. For the past ten years, these products have slowly made inroads in the use of vulcanite for this purpose, until today there are between forty and fifty of them, possessing certain advantages and disadvantages.

Broadly speaking, we may divide these materials or resins into two groups by reason of their processing: (1) thermosetting, or vulcanite like, and (2) thermoplastic, or celluloid-like. To permit of comparison with vulcanite, four new types of resins at present used in dentures have been selected: (1) the phenol-formaldehyde type (such as "iteco," "coedal," "C.E. 950" and "luxene"); (2) the glycerol-phthalic acid or alkyd type, such as "glycene"; (3) the vinyl type (such as "vydon" and "resovin"), and (4) the styrol type ("tepperite").

CHEMICAL NATURE

The exact chemical composition of these resins is not known. They all belong, along with rubber and celluloid, to the general class of high polymers. A "high polymer" means a substance containing very large molecules which have

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been formed by the union of a great number of single molecules or units, all of the same kind or pattern. To illustrate it more simply: These large molecules are like chains, the links of which are smaller molecules or units. Thus, a compound of one link 0 is a monomer, of two links 00, a dimer; of three links 000, a trimer; and of many links 0000000, a polymer. The gross materials themselves are a great mass of such chains either in an orderly arrangement or a heterogeneous, criss-cross mixup.

The units or links which make up the

Fig. 1.—Device for determining softening point of raw resin, ball and ring method (American Society for Testing Materials). In a jar of oil, with a thermostatically controlled heating device, a metal ring one-quarter inch thick is placed, having a tapered opening from top to bottom, approximately 1 inch wide at top. The ring is placed 1 inch above a metal plate near the bottom of the jar or tank. The material to be tested for softness is placed in the tapered opening in the ring, and upon this material is placed a three-eighths inch ball weighing 3.5 gm. The temperature of the oil medium is raised from room temperature at the rate of 9 degrees per minute. When the pressure of weight of the ball resting on the material causes the latter to extrude to the point where it touches the metal platform beneath, the temperature recorded at this time is considered the "softening point." "Luxene" sags at 140 degrees; softening point, 170 degrees.

chains differ for various substances. In the case of the phenol-formaldehyde resins, it is a compound of carbolic acid and formaldehyde; in the alkyd resins, a compound of glycerol and phthalic acid; in the vinyl resins, a compound of acetylene and acetic acid or acetylene and hydrochloric acid.

While we do not know, therefore, the exact structural make-up of these resins, we may divide them into two distinct classes; namely those which are first thermosetting, i.e., a chemical reaction known as polymerization takes place on

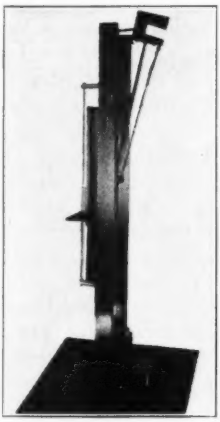

Fig. 2.—Device for determining impact or shattering strength (A.S.T.M.); dimension of test bar 2½ by ½ by ¼ inches; bar held in vise, broken by impact of hammer on falling and swinging through, carrying with it needle or arm which records breaking point in foot pounds. The weight of the hammer varies with the type of test.

further heating after they are molded under heat and pressure, and they set to a hard rigid material just as rubber and sulfur sets when it is vulcanized; and, secondly, those which are thermoplastic; i.e., no chemical reaction takes place when they are molded under heat and pressure, and the finished article is chemically the same as the molding compound from which it is made, just as celluloid, when

molded, is formed to the desired shape yet remains chemically unchanged.

We may classify the four types of resins under consideration, therefore, as follows: thermosetting (rubber-like); phenol-formaldehyde; alkyd; thermoplastic (celluloid-like); vinyl and styrol.

PERMANENCE OF COLOR AND APPEARANCE

All of the foregoing types, being translucent, are superior to vulcanite and celluloid in color and appearance. The permanence of color of a denture in use will depend on five factors: (1) the chemical purity of the ingredients; (2) the chemical processing in the hands of the individual manufacturer; (3) the effect of moisture and oral secretions; (4) the cleanliness of the individual user, and (5) the effect of light. Of the four types considered, the phenol-formaldehyde resins have been the most readily affected by light and the least affected by oral secretions. In testing the phenol-formaldehyde resins for color permanence by subjection to ultraviolet ray, a great difference was apparent in the results. Taking "coedal," "C.E. 950," "iteco" and "luxene" as samples, at the expiration of four hours' subjection, the first three named were definitely discolored toward a brownish hue, not acceptable for practical use; whereas the "luxene" remained apparently unchanged; at ten hours, the first three were definitely brown, and unfit for use, while at twenty-four hours, though altered somewhat when compared with the parent fragment, the "luxene" sample was still very satisfactory for use. The latter apparently represents a very marked improvement in color permanence

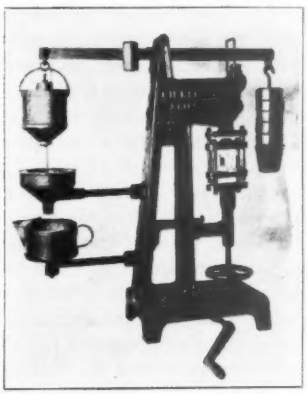

Fig. 3.—Device for determining transverse strength. The test bar rests on two anvils permitting or offering a one-quarter inch lap, leaving a 2 inch space. Pressure, exerted from the top with a fulcrum in the center of space, is applied through the releasing of shot at the rate of 600 lb. per minute.

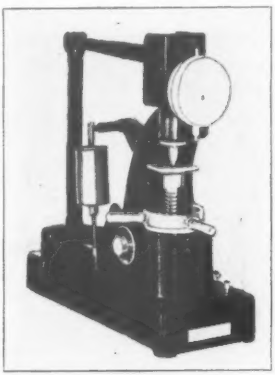

Fig. 4.—Device for determining hardness, standard Rockwell testing machine, a one-quarter inch ball pressing on material with a 220 pound load. Reading on Rockwell Scale (on B Scale): "Luxene," B 110; vulcanite, B 70-75; vinyl resin, B 65-70; celluloid, B 50. This machine is also used for the flow test by means of screw pressure of 10 kg. or 22 lb. against ball resting on the material for a period of time, of, say, twenty-four hours. The variance of the recorder on the gage indicates amount of flow. This test, if made at mouth temperature, would differ according to the foregoing, especially in the instance of thermoplastics.

in the phenol-resins, and can be considered practically permanent. The vinyl types are also practically impervious to light, and the alkyd type is considered fast.

TOUGHNESS AND RESISTANCE TO SHOCK

The vinyl resins, while seemingly tougher than vulcanite, may nevertheless develop strains when molded into forms such as dentures, fractures resulting. In all fairness to the material, it is not definitely understood whether these strains are attributable to faulty technic or to the presence of foreign objects having different coefficients of expansion, such as the porcelain teeth. The styrol resin as used for dentures has but fair resistance to shock. The phenol-formaldehyde type varies quite widely from the very brittle materials to those like "luxene," which are tough but not so tough as good vulcanite. Judging from tabulated foot-pound breakage tests, "luxene" can be regarded as three to four times stronger than some of the earlier phenol-formaldehyde denture resins.

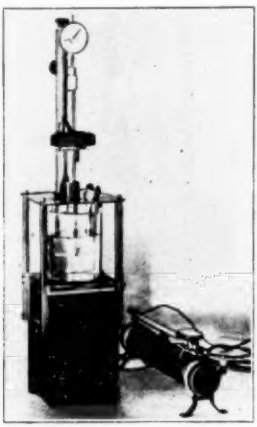

Fig. 5.—Device for determining rigidity (control test only). The test bar, 2½ inches by ½ by ¼ inch rests on an anvil such as was used in Figure 4 (transverse strength test), placed in oil with temperature control. With a 22 lb. weight resting on the bar, temperature increased from room temperature at the rate of one-half degree per minute. The rigidity point was reached when the bar had been distorted one-tenth inch. The Ames indicator records a movement of one ten-thousandth inch.

SURFACE HARDNESS

The phenol-formaldehyde type resins undoubtedly possess the greatest surface hardness, resembling porcelain in that respect. They take and retain a very high polish and are very resistant to abrasion; thus, they can readily be kept clean and sanitary. The alkyd resins are a very close second in this respect, and both may be considered about twice as hard as good vulcanite. The hardness of both the vinyl and styrol resins is less than vulcanite. As evidence of this, if a vinyl case is cut with a new vulcanite bur, shavings or curls are the result, not powder. If an inverted cone bur is used, the bur tends to gum up. If the case is cut with a saw, the two halves, after severing, remain together, demanding effort to break them apart. If a case is polished, the luster can be removed instantly by using a nonabrasive tooth paste between the thumb and finger. Thus, it must be said that the vinyl resins are more difficult to keep polished and abrade more readily, and are consequently less sanitary than either the phenol-formaldehyde or alkyd resins.

WATER RESISTANCE

The phenol-formaldehyde resins are by far the most water resistant of all three types, with the alkyd resins a close second. While the vinyl and styrol resins exhibit very low water absorption at room temperature, the water absorption rate increases with temperature. It becomes quite noticeable at 40 C., and they will not withstand the action of boiling

water. The alkyd resins, while exhibiting somewhat higher water absorption at room and mouth temperature than the phenol-formaldehyde and vinyl resins, are able to withstand the action of boiling water for many hours without the loss of color or deterioration in appearance.

POSSIBILITY OF REPAIR

It is doubtful that the repair of a vinyl resin will be satisfactory, and it probably will be no more permanent than that of the cellulose dentures. There will be some absorption of secretions, and the softness of the material lends itself to abrasion and consequent surface staining. The second heating will undoubtedly darken the denture, and there is some question as to whether the old, greasy material will adhere permanently to the new. Laboratory test repairs, even without the above-mentioned absorption, bear out this contention. "Luxene" can be repaired with the same facility as rubber, and "luxene" repair material, which is cured at much lower temperatures and in less time than the original denture, and enables the operator to effect a repair with no noticeable change of color, excellent union being obtained, equal to, if not surpassing, a repair with vulcanite.

RETENTION TO METALS

Experience with the various materials indicates that the phenol resins adhere to metals more closely than any of the thermoplastics. When pressed against metal, thermoplastic materials have a tendency to pull away, and if there is no roughened or stippled surface or undercuts, they will not adhere at all. The phenol resins, on the other hand, are not "pressed against the metal," but actually "baked" to it, and in consequence of the intimate contact thus obtained, the adherence to metal must be considered much greater than is the case with the thermoplastics. A thermocuring material, properly compounded, will contain no excess of volatiles to dry out and cause checking. In the case of the alkyd resin, "glycene," this adhesion to metal surfaces is superior even to that of "luxene."

RETENTION TO PORCELAIN

Nor is the retention of thermoplastics to the porcelain teeth as close as when thermosetting resins are used. It is possible that the excellent union with the teeth when the latter are used may be due to inherent qualities, such as great density, hardness, low absorption and inertness, and also the baked-on feature of this type of resin. The thermoset resins become very soft before the cure and flow closely around the necks of the teeth, a union resulting between teeth and resin which is extremely stable, thereby precluding any unsanitary seepage with use. Photomicrographs check this point, and incidentally disclose the pulling away from the necks of the teeth in the instance of the vinyl resin.

ACCURACY OF REPRODUCTION

Mr. Thomas Moore, of Ransom and Randolph, covered this item most adequately when he wrote:

> In our opinion this is the most important property that Luxene has over the thermoplastic materials, as well as practically all of the thermo-set materials. What we mean by accuracy of reproduction is to accurately reproduce even the exact thickness of the wax in the curing or pressing process. In the vulcanizing of a rubber case the thickness of the wax is increased about 0.01 of an inch, and regardless of the material used for flasking and the care taken in pressing a vinyl or styrol resin or cellulose material, the thickness of the reproduction will be much greater than the original wax. From results of our experiments here we find it impossible to press a form in vinyl resin without increasing the thickness of the original pattern 0.105 or more.
>
> We find that we can reproduce a form in

Luxene with an increase in thickness of only about 0.002. The reason for this discrepancy is the deformation or compressibility of the flasking material. The metal flask may be entirely closed, but when any of the flasking materials that are made from plaster are subjected to pressure, there is always a deformation, and this deformation increases directly as the pressure increases. Therefore it is natural to assume that when from five to ten thousand pounds pressure is used to close the flask, there will be considerable compressibility of this material.

The practical effects of this compressibility of the investing material are shown when the completed denture is put back on the original cast or articulator, or put on a Hooper Duplicator to show the exactness of the reproduction.

We have carried this test out with the various materials and always find that with the thermo-plastics the posterior teeth strike, leaving the bite open on the anterior teeth as much as one-eighth inch or more. This change in the bite is not so noticeable in the mouth as when it is measured with instruments, because of the compressibility and adaptability of the tissues. However, it has been quite a common practice to grind the posterior teeth until the articulation is reasonably accurate, when the thermo-plastics are used.

LENGTH OF LIFE

We have already considered certain factors in the life of a denture; namely, color change, breakage, surface hardness and moisture absorption. None of these is quite so important in the life of a denture as "change in shape." Such a change in the case of thermoplastic substances is often brought about by a process which may be called "elastic recovery." It is sometimes called "warping" or "cold flow."

We can better understand what is meant by "elastic recovery" if we review the process of forming a celluloid denture: A blank of the required size is taken, softened under heat and pressed to the desired shape. The piece is cooled and the denture is finished. There was no chemical reaction involved, and the finished denture is chemically the same as the blank from which it was made. What has been accomplished is merely a change in shape, a deformation and not a change in structure. No permanent change has been effected, and unless confined in a mold under pressure, the material tends to return to its original shape. This, then, is what is meant by "elastic recovery," and while particularly characteristic of celluloid and cellulose products, is also true to a certain degree of all thermoplastic materials. Remember, thermoplastics are "high polymers" structurally, with links forming long chains, but not cross-links or heterogeneously arranged links as in the case of thermo-setting resins and accounting for their rigidity.

The "elastic recovery" effect is greatly accelerated by the introduction of temperature and can be easily demonstrated by warming any of these thermoplastic materials outside the confine of a mold. This property of "slow change," "cold flow," is therefore an inherent weakness of all thermoplastic materials, and thus their permanence of shape and, consequently, length of life, will be dependent on the rate of this change at the temperature to which dentures are ordinarily subjected.

Contrasted with such materials, we have the thermosetting materials. Molding of these is accompanied by an actual chemical change, which permanently "fixes" or "sets" them to a hard, rigid structure which they will retain indefinitely. Such a change occurs when rubber is vulcanized and when phenol-formaldehyde and alkyd resins are molded under heat and pressure and cured. Dentures made from such materials are faithful reproductions of the original and are permanent.

"Hecolite," "alcolite," "dermatex," "parfait," "barthol," "vitagum" and many others comprising the cellulose

group (either cellulose nitrate or cellulose acetate) have been omitted from consideration, first, because they are not included in newer dentures base materials, and, secondly, because the profession must by this time realize that the products are unstable and definitely not suitable for denture bases. This is due presumably to the loss through volatilization of the plasticizer—in some instances, camphor.

The products comprising the cellulose group have high transverse strength. Their density may be considered fair, although we know that they contain a volatile evaporation which causes them to lose strength and form. There is seepage around the necks of the teeth caused by the shrinkage of material, and the permanency of form must be considered brief. The permanency of color is only of fair length, and the product is very unsanitary, absorbing up to 10 per cent of its weight in moisture. Reparability is low.

In summarizing our findings, we should probably enumerate the requirements of a practical denture base material, and make our selection accordingly. The requisites, then, of such a material should be:

1. A faithful reproduction of the original pattern.
2. Permanency of form even when subjected to temperatures higher than body temperature, such as would exist in the presence of hot coffee, tea, soup, etc.
3. Strength to withstand in the presence of heat, masticatory stresses and, to a degree, shock.
4. Nonabsorbency, in order to remain sanitary and not susceptible to stain.
5. Translucency, with lasting color.
6. Hardness and density, in order to permit retention of a high polish.
7. Reparability after the denture has been in service.

These requirements are not fulfilled by the styrol type resin, "tepperite," manufactured by the Naugatuck Chemical Company. To reiterate, it is a thermoplastic, incapable of faithful reproduction of the original pattern, not fixed in form and not especially strong, nor hard nor dense.

The vinyl resin, a product of Carbon and Chemical Co., is not of recent origin, having been on the market for several years as an ingredient of varnish, and also tried unsuccessfully as a denture base material four or five years ago. While receiving considerable publicity of late, it does not appear to measure up to our standards. Being thermoplastic, it cannot give a "faithful reproduction" in the true sense of the word; is not permanent in form in the presence of heat and pressure; is absorbent in temperatures slightly above mouth temperature, and is definitely soft. It seems reasonably strong, and the color is lasting. Its reparability especially after use is questionable.

The phenol-formaldehyde resins, more especially the latest one, "luxene," do appear to fulfil much that is demanded of a denture base, being perfect in reproduction, permanent in form in the presence of both heat and pressure, nonabsorbent, translucent, with lasting color, hard and dense, though not so tough as a good grade of vulcanite. From laboratory findings, together with ten months' practical use, I believe that "luxene" marks a great improvement over the other resins in this class. On breakage tests, it is from 25 to 50 per cent superior to other phenolic resins, and while earlier phenolic resins had a poor rating as regards color permanence, that of "luxene" is excellent.

The remaining alkyd resin, "glycene," manufactured also by the Bakelite Corporation, I consider the de luxe denture

base material at present at our disposal. It is not as yet the finished product which the company hopes to attain, but, even so, notwithstanding the occasional checked tooth and the painstaking technic involved, I believe "glycene" more nearly fulfils our requirements than any other product.

EFFECT OF PROCAINE-EPINEPHRINE SOLUTIONS ON THE PULSE RATE AND BLOOD PRESSURE*

By F. H. BORG, D.D.S., M.D., Chicago, Ill.

A CAREFUL study was made of the effect of procaine-epinephrine solutions on the pulse rate and blood pressure of 121 patients in the Cook County Tuberculosis Hospital who had to have teeth extracted. These patients were selected as subjects because they constituted a segregated group which could be closely observed. The condition of these patients was as follows: good, ambulant, fifty-four patients; good, semi-ambulant, nineteen patients; fair, bed patients, thirty-one; poor, bed patients, seventeen.

The first observations were made before anything was done to the patient; the second, two or three minutes after the injection of the anesthetic solution, and the third, after the extraction was completed, usually from ten to fifteen minutes after the first observation. In a few cases, only two observations were made, the first before the injection and the second after the injection of the anesthetic solution. Three procaine solutions having a different epinephrine content were used in each of three groups of patients. In each group, the mandibular, mental, zyomatic, infra-orbital and infiltration injections were used.

In the first group of sixty-three patients, a 2 per cent procaine solution with epinephrine in a dilution approximately 1:50,000 was used, and sixty-three different injections were made. In ten of these patients, only two observations were made, one before and one after injection; and of these, four patients showed an increase in pulse rate; five, a slowing of the pulse rate, and one patient, no change in pulse rate. Here, it might be observed that six of the ten cases showed the opposite reaction from what one might expect accompanying epinephrine administration. Of the remaining fifty-three patients on whom three observations were made, the results were still more variable, showing nine different reactions:

Four patients showed no changes in pulse rate.

Thirteen showed a sustained increase in pulse rate.

Ten showed an increase in pulse rate after injection, with a decrease after the extraction was completed.

Nine showed an increase in pulse rate after injection, with a further increase after extraction.

Four cases showed no change after injection, with an increase in pulse rate after extraction.

Four showed a drop in pulse rate after injection, with an increase after extraction.

*Read at the Seventy-Fifth Annual Session of the American Dental Association in conjunction with the Chicago Centennial Dental Congress, Aug. 11, 1933.

FREQUENCY CURVES
Changes in systolic pressure following injection expressed in mm. of Hg. pressure
Total number of observations in as many individuals = 115
Median change = +2
Average change = +3
Maximum change = +36 and -28
20
10
-30 -25 -20 -15 -10 -5 0 +5 +10 +15 +20 +25 +30 +35
Changes in diastolic pressure following injection expressed in mm. of Hg. pressure.
Median change = 0
Average change = 0 (+0.3mm.)
Maximum changes = +36 and -40
30
20
10
-40 -35 -30 -25 -20 -15 -10 -5 0 +5 +10 +15 +20 +25 +30 +35 +40

Fig. 1.—Frequency curves. Horizontal figures indicate the changes in blood pressure expressed in millimeters of mercury. Vertical figures indicate number of patients. (Maximum change in diagram above should be corrected to read +34 and —28.)

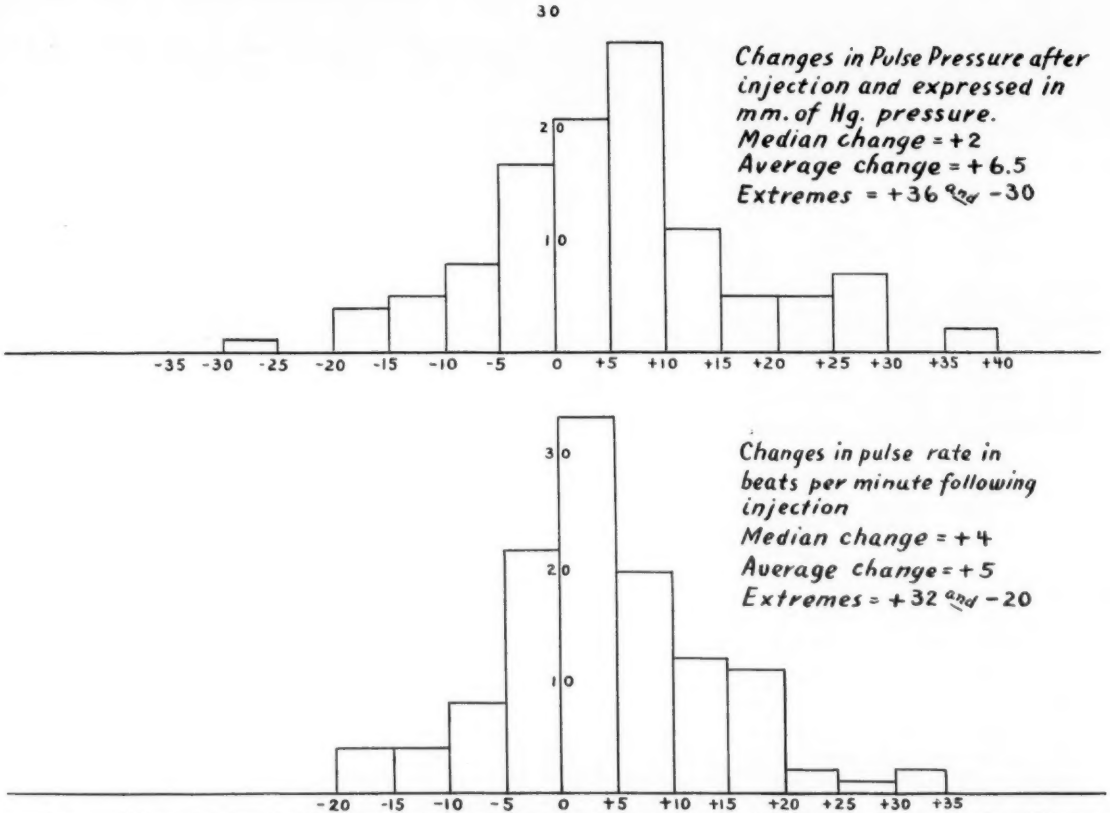
30
20
10
Changes in Pulse Pressure after injection and expressed in mm. of Hg. pressure.
Median change = +2
Average change = +6.5
Extremes = +36 and -30
-35 -30 -25 -20 -15 -10 -5 0 +5 +10 +15 +20 +25 +30 +35 +40
30
20
10
Changes in pulse rate in beats per minute following injection
Median change = +4
Average change = +5
Extremes = +32 and -20
-20 -15 -10 -5 0 +5 +10 +15 +20 +25 +30 +35

Fig. 2.—Above: Changes in pulse pressure. Horizontal figures indicate the changes in blood pressure expressed in millimeters of mercury. Vertical figures indicate number of patients. Below: Changes in pulse rate. Horizontal figures indicate the pulse rate in beats per minute. Vertical figures indicate number of patients.

Three cases showed a sustained drop after injection.

Three cases showed a drop in pulse rate after injection, with a further drop after extraction.

Three showed no change in pulse rate after injection, but a drop after extraction.

In studying the blood pressure, we found thirty-five combinations of changes in the sixty-three patients. In twelve of these patients, the blood pressure was taken only twice, the first before injection and the second, two or three minutes after injection, with the following results:

Five patients showed no change in blood pressure.

Two patients showed a rise in systolic and diastolic pressures after injection.

Two patients showed a rise in systolic pressure and no change in the diastolic.

One patient showed a rise in the diastolic pressure with no change in the systolic.

One patient showed a fall in both the systolic and the diastolic.

One showed a fall in diastolic pressure, the systolic remaining unchanged. Of the remaining patients in this group, three observations were made: before and after injection of the solution and after the extraction was completed.

In three patients, there was no change in the blood pressure.

In three patients, there was no change in blood pressure after injection; but after completion of the extraction, there was a fall in both the systolic and the diastolic blood pressure.

In one patient, there was no change after injection, but a rise in both systolic and diastolic pressure after the extraction was completed.

In twelve patients, there was a rise in both systolic and diastolic blood pressure after injection. In one of these cases, the blood pressure remained the same after the extraction was completed. In the eleven other patients, the blood pressure changes following extraction of the teeth were as follows:

In two patients, there was a further rise in systolic and a fall in the diastolic pressure.

In two patients, the systolic pressure only returned to normal, the diastolic remaining high.

In two patients, the diastolic pressure returned to normal, the systolic remaining high.

In two patients, the systolic and diastolic both returned to normal.

In three patients, the systolic and diastolic pressure both dropped below normal.

In eight patients, there was a rise in systolic pressure only after injection, with the following changes after extraction.

In five patients, the blood pressure returned to normal.

In one patient, there was a fall in both systolic and diastolic.

In one patient, there was a further rise in the systolic pressure, the diastolic remaining unchanged throughout.

In one patient, a further rise in systolic pressure and a rise in diastolic pressure occurred.

In seven patients, there was a rise in systolic with a fall in diastolic pressure after injection. After extraction:

One patient showed a fall in systolic pressure.

Two patients showed a fall in systolic, with a further fall in diastolic pressure.

In two patients, the changes were persistent.

Two patients showed a rise in diastolic pressure, the systolic remaining the same.

In ten patients, there was a fall in both systolic and diastolic blood pressure after injection.

of mercury. Vertical figures indicate number of patients. Below: Changes in pulse rate. Horizontal figures indicate the pulse rate in beats per minute. Vertical figures indicate number of patients.

After extraction:

In one patient, the blood pressure remained the same.

In four patients, the blood pressure returned to normal.

In four patients, there was a further fall in both systolic and diastolic pressures.

In one patient, there was a rise in both systolic and diastolic pressures above normal.

In two cases, there was a fall in systolic pressure after injection, and, in one of these, there was a rise in the systolic pressure above normal after extraction, while the diastolic pressure remained unchanged. In the other case, there was a slight rise in both systolic and diastolic pressure after extraction.

In two patients, there was a fall in systolic and a rise in diastolic pressure after injection. In one of these cases, the change persisted after the injection; in the other, the blood pressure returned to normal.

In two patients, after injection, there was a fall in diastolic pressure only. In one of these cases, there was a fall in the systolic pressure after extraction. In the other, the blood pressure returned to normal.

In one patient, it was impossible to obtain a blood pressure reading.

With the use of solution No. 2, consisting of 2 per cent procaine and epinephrine in a dilution of approximately 1:20,000, on nineteen patients with twenty-four different injections, the observations on pulse rate showed eight different results. These were as follows:

In seven cases, progressive increase in pulse rate after injection and after extraction.

In three cases, increase in pulse rate after injection, with a slowing of the pulse after extraction.

In three cases, no change in pulse rate after injection, with an increase in pulse rate after extraction.

In one case, no change in pulse rate.

In one case, no change in pulse rate after injection, with a slowing of the pulse after extraction.

In one case, persistent slowing of the pulse.

In one case, progressive slowing of the pulse.

In two cases, slowing of the pulse after injection, with an increase after extraction.

The observations on blood pressure showed fifteen different combinations of changes in the blood pressure determinations of the nineteen patients. These variations were of the same general character as shown in the results obtained from solution No. 1.

Solution No. 3, containing 2 per cent procaine and epinephrine approximately 1:27,000, was given thirty-nine patients with forty-six different injections. Here also, we found eight different responses in pulse rate and twenty-two combinations of changes in blood pressure.

It should be mentioned here that, in many cases, the first pulse rate recorded was compared with the pulse rate as recorded on the hospital chart for that day, and frequently it was found that the pulse rate had increased from ten to twenty beats per minute as soon as the patient was aware of an impending extraction and before any solution was injected.

In view of the fact that there was no consistent change in pulse rate and blood pressure following the administration of the anesthetic solution, it seems reasonable to assume that many of the variable changes observed were due to other conditions such as psychic reactions and the tension of the patient, rather than to the small amounts of drug administered.

It would seem that the small dosage of procaine-epinephrine as employed in local anesthetic solutions has no consistent relation to the variations observed in pulse rate or blood pressure. If this is true, it would appear to follow that the operator employing local anesthetic solutions as used in the practice of dentistry need not fear that any possible blood pressure or pulse rate changes occurring before, during or after operation are caused by injection of the anesthetic solutions *per se*. On the other hand, the operator should be aware of the possibility of alarming or serious reactions of the circulatory system in apprehensive, nervous persons that occur during dental operations performed under local anesthesia. A skilful handling of the patient, minimizing his fear and pain, probably is of more importance in controling these circulatory reactions than the amount of procaine-epinephrine used. If more procaine is necessary to produce adequate anesthesia, it should be employed without hesitation, because the assurance of a painless procedure is of more importance in preventing circulatory upsets than is the hypothetical toxic effect of an increased anesthetic dose.

CLICKING OR SNAPPING JAWS

By E. F. THOLEN, M.D., D.D.S., and F. S. BALYEAT, M.D., D.D.S.,
Los Angeles, Calif.

A RECENT review of our cases of clicking temporomandibular joints interested us very much because it seemed a rather frequent complaint and, in many cases, caused much discomfort and annoyance. A search of the literature revealed few articles that shed much light on the subject. This may be due to the fact that the joint is rarely subjected to exploratory operation and to the few recorded postmortem findings of the condition. A few years ago, one of us (F. S. B.) sent a questionnaire to forty oral surgeons in an endeavor to get their viewpoints. Their opinions and conclusions varied considerably.

ETIOLOGY

There is a marked difference of opinions as to the causes of this condition, and it is hard to substantiate any of the theories advanced. The answers to the questionnaire showed that the majority believe trauma to be the chief cause. The remainder thought arthritis, nervous habits of grinding the teeth and the presence of loose ligaments to be the principal cause. We failed to find any predisposing factors, such as age, sex or occupation, to have any bearing on the condition.

Of the direct causes, we found that trauma was perhaps the most important factor. The history shows that many of these cases often begin months or years before any one is consulted regarding the case and, as a result, the patients often overlook any possible traumatic factor. The common causes are blows on the chin and strain on the joint from having the mouth opened excessively wide or for a prolonged period of time, as in dental operations and in difficult extractions. Biting unsuspectingly on large or hard

substances such as fruit pits may cause the condition; also violent sneezing or coughing. We have had several cases that followed changes in occlusion after the insertion of dental bridges or partial plates and in which cures resulted when the wearing of them was discontinued. In most of the cases which are caused by trauma, we believe the snapping or clicking is due to an abnormal slipping of the cartilage, which has been torn loose or been damaged by some violent action of the pterygoid externus. In most cases, the cartilage is intact and in one piece, but several cases have been reported where the disk was found to be split into several pieces.

REPORT OF CASES

L. R., a white man, aged 24, fell and struck his chin on the edge of a swimming pool. This caused a fracture of the neck of the right condyloid process and painful clicking in the left joint. The jaw was immobilized by interdental wiring of the upper and lower teeth for six weeks. On removal of the appliances, it was found that the clicking had disappeared and the patient had good occlusion of the teeth, with good jaw action.

C. J. B., a middle aged white woman, had all the posterior teeth extracted in January, 1927. The extractions were difficult. Partial plates were inserted a few months later but were never satisfactory, although many adjustments were made. She came in in October, 1927, with a complaint of cracking and distress in the left joint of three months' duration. On examination, there was a distinct coarse click on opening and closing the jaw in the left joint. New plates and restriction of jaw action were suggested. In 1931, the patient returned because of an acute dentoalveolar abscess and, on being questioned regarding the clicking, she stated that she had not worn her plates since her previous visit and that she had no more trouble in the joint. This was verified by examination.

F. S. B., in 1930, unknowingly bit on some hard substance. This was immediately followed by severe pain in the right temporomandibular joint, which lasted for several days. The soreness gradually disappeared, but an audible and palpable clicking followed, lasting for three months. On restriction of the jaw action, the clicking entirely disappeared.

In our cases, arthritis was the second most important etiologic factor. We believe that cases associated with arthritis usually have a fine grating or crepitation in contradistinction to the usual coarse single click. Two of our arthritic cases showed definite joint changes in the roentgenogram. The diagnosis in these was based upon the history, the local signs and the finding of arthritic joints elsewhere in the body.

R. R., a white man, aged 41, came in in October, 1931, complaining of pain and crepitus of the right temporomandibular joint and restricted jaw action. About January, 1930, he noticed clicking in the right temporomandibular joint with no pain and from no apparent cause. One year later, the clicking disappeared with no treatment. Progressive soreness in the joint and back of the ear followed, with some limiting of jaw motion, the jaw deviating to the right. The patient had had no treatment except that, three months prior to his coming in, a physician injected the joint area with magnesium sulphate, with no relief. The family history was negative. The patient had always been in excellent health.

Examination revealed that the lower jaw deviated from 6 to 7 mm. to the right and opened 2.5 cm. in the midline. There was a fine crepitus in each temporomandibular joint, but more noticeable on the right. The occlusion was good. There was no dental reconstructive work.

Roentgenograms of both temporomandibular joints showed a joint space of 5 mm. on the right as compared to 2.5 mm. on the left and the joint surface of the right condyle was definitely roughened as compared with the left.

In 1920, C. D. B., a boy, aged 13, came to the office complaining of crepitus in the right joint. At the age of 11, he had an attack of scarlet fever which was complicated by severe bilateral otitis media. Four or five months after the infection, he could not open his mouth fully and noticed fine crepitus in the right joint. We did not see him again for ten years. He returned in 1930, complaining of ankylosis of the right temporomandibular

joint. Examination revealed a bony ankylosis of the right joint. Arthroplasty was performed, with a good result.

Mrs. J. G., aged 40, came into the office complaining of pain and crepitus in the right joint of five or six months' duration. From the history, no cause could be found except the fact that there was some trouble in the knees which she had been told was arthritis by a competent physician.

Examination revealed numerous fine gratings or crackings in the right joint. The roentgenograms revealed the right joint space to be 1 mm. narrower than the left.

From the questionnaire, it was found that 15 per cent believed that arthritis was the sole cause of all cases, 50 per cent believed that arthritis was the cause in a small percentage of cases, 10 per cent believed that arthritis was never the cause and 25 per cent did not express an opinion.

The third factor to be considered under etiology is loose ligaments. In some of our cases, the condyles were more prominent on motion than was normal. We believe with Wakely[1] that, in the older snapping cases, there is a relaxation and stretching of the articular capsule, ligaments and possibly muscles which tend toward a vicious circle. We doubt that looseness of the ligaments is the cause of this condition, but believe rather that they result from trauma or an effusion in the joint.

In answer to the questionnaire, one oral surgeon stated his belief that loose ligaments was the sole cause in all cases; 40 per cent believed that loose ligaments were seen in old cases and associated with other loose periarticular structures, and 35 per cent did not express an opinion; while 15 per cent thought that a few cases were caused by looseness of the ligaments.

We have seen no case in which a general disease such as syphilis or tuberculosis caused changes in the joint accompanied by snapping.

The chief symptoms and signs of this condition are snapping, popping, grating or clicking. These vary in character and degree, but, in the majority of cases, there is only a single coarse click or snap on opening the jaw wide. This is easily felt and is often audible. A certain percentage of the cases have pain and soreness about the joint area or in the area of distribution of the auriculotemporal nerve.

In many of our cases, the patients learned that the pain and soreness was aggravated by opening the mouth wide, thereby bringing on a snapping sensation. Many complained of restricted jaw action, which was again due to having learned that wide opening exaggerated the symptoms. We thought this was particularly true in arthritic cases.

The treatment of our cases has been along conservative lines. In the early cases, we advise the patient to use only soft foods and to rest the jaw as much as possible. We make a careful study of the occlusion, and if we find that this has been changed by recent dental work, we advise correction. If the condition causes much annoyance, we apply orthodontia bands with lugs to the bicuspids and first molars and direct the patient to apply rubber bands to the lugs and thereby restrict the jaw action. In two cases in which the symptoms were especially annoying, we preceded the use of orthodontia bands by wiring the teeth in occlusion. As an aid to the foregoing treatment, we advise the application of diathermy to the joints.

If arthritis is the cause, all foci of infection should be removed and general measures used to improve the health. Local treatment to the joint, such as potassium iodide ionization and deep heat, may be helpful.

1. Wakeley, C. P. G.: Lancet, 2:543-545 (Sept. 14) 1929.

In new cases with sudden onset and pain or partial dislocation a symptom, Pringle[2] and also Wakeley advise attempting to replace the cartilage. The method used is to apply continued pressure behind the condyle with the mouth open for several minutes, then slowly close the mouth. Several attempts may be necessary.

Annandale,[3] in 1887, advised suturing the cartilage to its proper position. This method never gained adherents and has been abandoned in favor of excision of the cartilage. In 1918, Blake[4] emphasized the difficulties of operating on this joint. We fully agree with him and believe that the joint should not be opened until all conservative methods have been tried. Excision of the cartilage has been done with reported good results by Ashhurst,[5] Ivy, Wakeley[1] and Sir Holburt Waring.[6]

2. Pringle, J. H.: Brit. J. Surg., 6:385 (Jan.) 1919.
3. Annandale, Thomas: Lancet, Feb. 26, 1887, p. 411.
4. Blake, J. B.: Ann. Surg., 68:141 (Aug.) 1918.
5. Ashhurst, A. P. C.: Ann. Surg., 73:712 (June) 1921.
6. Waring, Holburt: Proc. Roy. Soc. Med., May, 1930, p. 940.

The last two mentioned report that a transient paralysis of some branches of the facial nerve occurred, which cleared up spontaneously.

In cases in which rest of the part and building up of the patient does not give relief, G. M. Dorrance advises the production of traumatic arthritis. This he does by irritating the surface of the condyle with a sharp instrument. The object is to more or less fix the disk and contract the joint.

CONCLUSIONS

1. We believe that the majority of these cases are due to trauma.
2. Arthritis is the cause in a small percentage of cases.
3. The symptoms are mainly due to displacement or pathologic changes in the interarticular disk.
4. The treatment should be conservative, preventive measures, restriction of jaw action and diathermy being used. If this does not give relief, operative procedures should be tried.
5. The operation of choice is the removal of the disk.

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ESSENTIAL FACTORS IN THE TRIAL BASE AND THE TRIAL DENTURE*

By VICTOR H. SEARS, D.D.S., New York City

THE trial base is entirely suitable for trial only if it possesses the same character of surface, the same adaptation, the same border extension and the same buccal and labial thickness as the proposed denture base. These are qualities that are generally recognized by careful prosthetists. In addition, there is another which may be incorporated, the quality of transparency.

There are two reasons that a trial base should be transparent: that any imper-

*Read at the Seventy-Fifth Annual Session of the American Dental Association in conjunction with the Chicago Centennial Dental Congress, Aug. 10, 1933.

fection of the valve seal which allows the ingress of air may be readily detected and that the effect of the denture base on the supporting tissues during biting pressure may be observed. Those areas which receive the greatest pressure become blanched as force is exerted on the transparent base. The operator can observe which portions of the supporting tissues appear white under load and, if necessary, provide for relief. This is especially useful when it becomes necessary to learn exactly which areas cause a base to rock. Needless to say, the transparent base must be made with the same precision as the ultimate denture base, because only then will it indicate accurately the adaptation and retention to be expected in the completed denture.

JAW SEPARATION

The trial dentures themselves should, first of all, fix the desired degree of jaw separation. While this should be largely a laboratory operation, it must be studied with the trial dentures in the patient's mouth. Any change indicated in this relation should first be made before a final decision on the other phases.

FACIAL CONTOUR

With the degree of jaw separation satisfactorily fixed and before attention is given to the positions of the teeth, it will save time and aid in the general arrangement to restore the lips and cheeks to the desired fullness. This phase of restoration should have been given attention during the making of the impressions, but must be finally checked with the trial dentures in position. It is, of course, to be borne in mind that the tissues of the face will gradually drape themselves over the restoration when any great change is made in degree of jaw separation or in facial fullness. In such instances, the end-result cannot be fully seen with the trial dentures. The ultimate effect must be partly perceived and partly anticipated.

APPEARANCE OF THE TEETH

One should aim to produce dentures which are not only pleasing, but also natural in appearance. This goal can be reached only when the teeth harmonize with that which Nature might have produced in four main particulars: size, form, color and arrangement.

The combined width of the maxillary incisors and cuspids is of more importance than the width of the upper central incisor, which is generally considered when discussing tooth size. Slightly larger central incisors should be chosen in cases wherein the lateral incisors are to be narrow so that the combined over all width remains constant. Other factors being satisfactory, suitably formed incisors, which are larger than the conventional one sixteenth of the greatest facial width, may be safely used. It is only in the case of inappropriate teeth that the size should be reduced to make the teeth inconspicuous. Bicuspids should be of such proportions that they appear to have erupted in the patient's mouth instead of having been selected at the tooth counter with the idea of just about filling a space between the casts mounted on an articulator. Contrary to the idea one might gain from observation of factory-made teeth, the crown portion of the natural maxillary first bicuspid is both wider and longer than that of the second bicuspid and should be so in the restoration.

The form of the tooth is important, but the outline form of the maxillary central incisor need not follow the outline of the patient's face. Teeth, to appear well in the patient's mouth, must, of themselves, be pleasing to the eye. It is vastly more important to make the composition good to look at than it is to attempt to follow the outlines of the

patient's face, especially if the facial outlines are not particularly pleasing.

At the trying-in stage, the teeth should have been modified by slight flattening of the proximal contacts and grinding of the incisal edges according to the age of the patient, and the wax gum should be complete in its contour to form the fourth side of the tooth. Of the four sides of an incisor—mesial, distal, gingival and incisal—the incisal is the most neglected and at the same time the most important. This edge requires grinding to simulate wear and the effect should be present in the trial dentures.

Tooth color is one of the important phases to consider, and yet it is a matter of common observation that pleasing natural dentures vary within rather wide, but nevertheless definite, limits for a given set of facial factors. In other words, there are for each patient many color combinations which will appear both pleasing and natural. With the general run of present commercial shade-guides, it is more important to eliminate those numbers which are unsuitable than it is to attempt fine points of differentiation in the actual selection. It is no reflection on the dental profession that some of us are unable to produce a higher degree of color harmony in a given case without consultation. Human beings vary widely in degree of color perception, and even slight color-blindness is a permanent handicap. This rather prevalent handicap may be largely overcome by studying the shade-guide and avoiding those numbers which produce disharmony as judged by those whose vision is complete and is trained for the purpose. Until one has reduced color selection to a workable system, he should seek consultation with other dentists at the time the trial dentures are in the patient's mouth.

While teeth for middle aged and elderly patients should not all be of exactly the same color, there should be only slight color differences among the teeth. The effect of variety should be produced mainly by altering the shade or darkness of a tooth, rather than "staggering" or mixing the colors themselves.

The distribution of color and shade in the tooth itself is of great importance in producing natural effects. Unfortunately, there are in this country no artificial teeth thus far available which closely simulate natural ones in this important particular. Not only should the gray of the enamel extend across the incisal edge from mesial to distal aspect, but it should extend along the proximal borders as well. Until the manufacturers produce teeth with more natural color distribution, we may approximate the effect by removing the glaze from those portions which we wish to have appear gray. While most of this selection and preparation should be done prior to the trying-in stage, often additional alterations will suggest themselves to the dentist with the trial denture in the patient's mouth.

Last of all, one should check the tooth arrangement from the three standpoints of esthetics, phonetics and mechanics, which are so closely related that securing one helps in arriving at the other two.

The esthetic and phonetic tests are made simultaneously by engaging the patient in conversation. The appearance can best be judged by concentrating the attention of the patient on the production of such sounds as s, sh, th, f and e. Minor changes in tooth position will usually suggest themselves. It is advisable to make such changes at the trying-in; both because the alteration can be passed on and because this finishing touch engenders confidence in the patient's mind as to the dentist's endeavor to attain the most pleasing result.

The teeth of the trial dentures should

be finally checked for excentric occlusion —protrusive, right and left lateral. In protrusive occlusion, the posterior teeth should make slightly heavier contact than do the anterior ones; in lateral occlusion, the balancing side should make slightly heavier contact than does the working side. One reason for this precaution is that the steps necessary to the completion of the dentures tend to cause premature contact on the incisors and on the working cusps. Settling of the denture bases during wear has the same tendency, which should be anticipated. Ultimate errors of premature contact in protrusion are more satisfactorily corrected on the posterior teeth than on the incisors, and those of premature contact in lateral occlusion are more satisfactorily corrected on the balancing lingual cusps than on the working buccal ones.

Having passed on the degree of jaw separation, facial contours and the teeth themselves as to size, form, color and arrangement, it remains only to assure the desired wax contouring around the gingival portions of the teeth and to implant in the patient's mind such suggestions as will influence him to take pride and satisfaction in his new dentures.

IS PERIODONTOCLASIA CURABLE?

By ARTHUR H. MERRITT, D.D.S., F.A.C.D., F.A.A.P., New York City

A QUESTION raised almost daily in the office of the periodontist by the patient who comes in for the first time for treatment is "Can pyorrhea be cured?"; a question usually followed by the remark, "My dentist says it is incurable."

In order that there may be no misunderstanding on so important a question, it is necessary to define what is meant by cure. If it should mean, as some seem to think, a restoration to normal, that is, to "the ordinary or usual condition" as normality is defined in the dictionary, it can be said that pyorrhea cannot be cured. The patient who has lost half of the alveolar process from around his teeth, with the usual gum recession and development of tooth mobility, cannot, in these respects, be restored to normal, no matter how successful treatment may be. The receded gums, the loosened teeth and the destroyed alveolar process will continue as a reminder of the destructive nature of periodontoclasia and of the importance of its prevention or early treatment.

"Cure" does not mean a restoration to normal; that is, to "the ordinary or usual condition," but "a restoration to health," which is the dictionary definition of "cure." A decayed tooth, for example, cannot be restored to normal, but it can be cured of the carious process, and, at the same time, be restored to health, which, after all, is the end of all treatment.

With this then as the definition of "cure" (which is the correct one), it can be said, without fear of successful contradiction, that periodontoclasia is a curable disease, though, like many other diseases, it may reach an incurable stage if treatment is too long deferred.

Another query often addressed to the periodontist by the patient with the advanced case is "Why didn't my dentist tell me before that I had pyorrhea?"—always an embarrassing question.

If, then, periodontoclasia is a curable

disease, what are the successive steps in its treatment?

1. A careful examination of the entire mouth with especial attention to the soft tissues. This should include a complete roentgen-ray examination; for in no other way can one determine the condition of the alveolar process and the extent, if any, of its absorption. A knowledge of the frequency with which bone loss resulting from periodontoclasia will be found to be present in adult patients will come as a great surprise to any one who has not made this a rule in his practice. Black[1] reports having found that 13 per cent of 600 patients between the ages of 20 and 24 had periodontoclasia, the incidence increasing to 88 per cent in patients over 50.

Inquiry should also be made regarding the patient's general health, habits of diet, etc., and when the facts elicited are believed to have some bearing on the case in hand, proper steps should be taken to correct the existing conditions. This may require the cooperation of the physician.

2. Treatment of cases in the earlier stages by subgingival curettage. This consists in the passage of an instrument into each pocket and removal from the involved root surface of all deposits of calculus and the remnants of the dead pericementum. This, of course, needs to be done thoroughly and carefully and when so done will arrest the disease and reestablish health in the periodontal tissues. The instruments required for this treatment are curets and planes, of which a half a dozen of each will be sufficient in most cases. Such attention to the occlusion as may be necessary to avoid excessive occlusal strain should also be given.

3. In advanced cases, in which half or more of the alveolar process has been destroyed, resort to surgical measures. As the different types of operations applicable to these cases have been often reported,[2] they will not be outlined here. As a rule, such cases should be referred to the periodontist. In this connection, it should be said that the prognosis will depend on the extent of bone loss, the number of teeth remaining to bear the stress of mastication and the patient's recuperative ability. When the family dentist, to whom the patient naturally turns for the solution of all his dental problems, assumes his rightful place in the treatment of periodontia, there will be fewer cases requiring surgical interference.

4. The establishment and maintenance of a high standard of mouth hygiene. This requires the cordial and persevering cooperation of the dentist and the patient. The dentist should carefully instruct the patient in methods of correct toothbrushing including a demonstration in the patient's mouth, advising him regarding toothbrushes, dentifrices and other equipment. He should arrange to see the patient at regular intervals for prophylactic care. The patient's responsibility consists in following instruction; for unless this is done, a full measure of success cannot be expected. So important is the patient's daily care that great pains must be taken by the dentist to assure its being carried out.

With such cooperation intelligently carried out, the treatment of periodontoclasia becomes one of the most satisfactory procedures of dental practice; for, even in advanced cases, periodontoclasia is a curable disease.

580 Fifth Avenue.

1. Black, A. D.: Roentgenographic Studies of Tissues Involved in Chronic Mouth Infections, J.A.M.A., 71:1279 (Oct. 19) 1918.

2. Merritt, A. H.: Periodontal Diseases; Diagnosis and Treatment, New York: The Macmillan Company, 1930, p. 130.

DENTAL CONDITIONS AMONG THE FIJIAN NATIVE YOUTH

By A. GAULT, Suva, Fiji Islands

THE rapidly increasing dental decay throughout the world has been one of our most complex problems. Whether it is due to some instability in matter, a consequent of the change which time is producing in all things, or to man-made environmental influence, due to modern civilization, both these conditions must be taken into consideration in our endeavor to arrive at the cause. And we must not be deterred by the apparent forces against us. I have not mentioned inherited characteristics because, in my opinion, they are the direct expression of our adaptability or lack thereof to our environment.

Much has been written concerning the part played by diet, but as yet we have not determined the menu which will to a great extent reduce the present incidence of decay. One would naturally think that the ideal physical condition could be produced by an exact expenditure of the energy obtained from food and other sources. But even this theory seems somewhat at a disadvantage when one takes into consideration the life of the average native, who indulges himself in the maximum amount of leisure with the minimum amount of work, well braced with a bountiful supply of the food which he most desires. Yet the physical condition of this man might well make envious many another who devotes his leisure to physical improvement. The Fijian native is such a man.

As Fiji is situated within the tropics, the Fijian, from his earliest childhood, enjoys to the fullest the advantages of the sunshine. He wears a minimum of clothing in his native state. This habit no doubt affects the state of his teeth, and is a factor in his high resistance to the inroad of decay.

The food of these people consists of fruit, vegetables and fish, and has done so since their arrival in Fiji, and where this diet is still maintained, there is little doubt that the dental conditions are much better than that of those nearer the towns, who follow the diet adopted by the average white person.

Another fact worthy of mention is that the Fijian prefers all his food cool or cold. I use the world "cold" as descriptive of the temperature of food which has been removed from the fire for about an hour or so, and which is never colder than the daily temperature.

For some time, I have been deeply interested in the phosphorus deficiency theory put forth by Dr. Lennox, of South Africa. As we all know that phosphorus plays an important part in calcium metabolism, it is surely feasible to suppose that stability and resistance to the invasion of caries would depend on the phosphorus content of food. To the best of my knowledge, the Fijian has never used manure of any kind in the cultivation of his foodstuff. Therefore, the phosphorus content should be the same today as it was before the advent of the white man. Yet today, decay is

evident in even remote parts of the group, far removed from town influence. Twenty years ago, it was a rare thing to see a native with a decayed tooth. I feel sure that although phosphorus content must play some part in the present dental conditions, it is not the only factor. Perhaps, the imbalance between the expenditure of energy and intake of food to produce that energy may have something to do with it, as in the example of the teeth of the people of Tristan Da Cunha.

The Fijian child has never been taught to use any artificial method to clean the teeth, although it is fairly common now to find young men and women who have adopted the use of the brush and the dentifrice. Fijians have never used milk in their diet until recent years.

I have chosen the years between 6 and 16 as showing the period most marked by dental decay.

Through the courtesy of the Hon. James Russell, director of education, Fiji, I am able to show the accompanying tables, which are typical.

TABLE 1.—DENTAL EXAMINATION AT PROVINCIAL (BOYS') SCHOOL, LAU*

No. of Fijians between ages of 6-16 examined, 70.
No. with no cavities in teeth, 61.
No. with no teeth extracted, 70.
No. showing crowding of teeth, 7.
No. of days per week meat is eaten, 7.
No. of days per week fish is eaten, 0.
No. of days per week white bread is eaten, 7.
Vegetables eaten: sweet potatoes, taros, yams, but mostly tapioca; occasionally onions, cabbages, carrots, beans, tomatoes.
*Reported by Ed. Tui-Vanuava Cakobau.

TABLE 2.—DENTAL EXAMINATION AT MATAVELO (GIRLS') SCHOOL, BA*

No. of Fijians between ages of 6-16 examined, 120.
No. with no cavities in teeth, 67.
No. with no teeth extracted, 105.
No. showing crowding of teeth, 6.
No. of days per week meat is eaten, about 3 times a month.
No. of days per week fish is eaten, 5.
No. of days per week white bread is eaten, 1.
Other foods eaten: yams, sweet potatoes, tapioca, corn, kawai, breadfruit, cabbages, taro, ivi nuts, bananas, a flower of a reed.
*Reported by P. Brokenshire.

TABLE 3.—DENTAL EXAMINATION AT CAWACI GIRLS' SCHOOL*

No. of Fijians between ages of 6-16 examined, 41.
No. with no cavities in teeth, 39.
No. with no teeth extracted, 34.
No. showing crowding of teeth, 0.
No. of days per week meat is eaten, 1.
No. of days per week fish is eaten, 3.
No. of days per week white bread is eaten, 1.
Other foods eaten: sweet potato, taros, tapioca, cabbages, spinach, pumpkins, bananas, yams.
*Reported by Sister Angela

TABLE 4.—DENTAL EXAMINATION AT PROVINCIAL (BOYS') SCHOOL, NORTHERN*

No. of Fijians between ages of 6-16 examined, 82.
No. with no cavities in teeth, 53.
No. with no teeth extracted, 62.
No. showing crowding of teeth, 1.
No. of days per week meat is eaten, 5.
No. of days per week fish is eaten, 0.
No. of days per week white bread is eaten, 7.
Vegetables eaten: native (yams, taros, tapioca).
*Reported by the headmaster.

TABLE 5.—DENTAL EXAMINATION AT SOUTHERN PROVINCIAL (BOYS') SCHOOL, SAWANI, REWA, FIJI*

No. of Fijians between ages of 6-16 examined, 78.
No. with no cavities in teeth, 64.
No. with no teeth extracted, 59.
No. showing crowding of teeth, 8.
No. of days per week meat is eaten, 7.
No. of days per week fish is eaten, 0.
No. of days per week white bread is eaten, 7.
Vegetables eaten: taro, tapioca, yams, sweet potato.
*Reported by G. Arthur, headmaster.

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Editorials

THE DENTAL CURRICULUM

In the June, 1933, issue of THE JOURNAL, an editorial entitled "An Important Curriculum Study" announced the appointment of a committee on curriculum by the American Association of Dental Schools. At the recent meeting of this association, March, 1934, the committee made a report, which was discussed at some length.

Never has the question of a dental curriculum been subjected to such scrutinizing care as was the case in this instance, and that much good may come from it, there can be no doubt. Many keynotes were sounded during the progress of the recent meeting, one of them being an observation made by the chairman of the committee, Dr. Wallace Seccombe: "The road of progress is not always a straight upward climb. There may be many deviations on the way. But we must ever keep in mind that we are of one company and if we are to reach our objective we cannot as individual groups always choose our own paths, or travel roads whose general trends diverge." This may be taken to mean that while the fine

impulses of an aggressive individualism in dental teaching can never be wholly subjugated by what we may term a consensus of opinion, the fact remains that, for the best interests of dental education as a whole, we must ultimately bow to this same consensus of opinion. In no other way can real advancement obtain.

Another keynote was found in an observation made by the executive secretary of the committee, Dr. L. E. Blauch, to the following effect: "We particularly tried to emphasize the point that we have not surveyed the dental schools. In fact, we have not been especially concerned with dental education as it is now operated. Our main purpose has been to prepare a suggested undergraduate course of study for educating men and women to engage in the general practice of dentistry."

In furtherance of this idea, there are two recommendations that are specific enough in their way to deserve consideration: first, that two years be required for education in liberal arts and sciences for admission to a dental school, and, second, that the dental curriculum be four years. This two-four plan has been in operation in certain of our schools for some time, and the result is being watched with much interest. It is probably too early to make a definite statement as to the practicability or otherwise of such a plan for all dental schools in the various environments and under all of the conditions that prevail in the forty odd schools of the continent.

One thing especially should be emphasized: that "dental education be continued and further developed in an autonomous field of professional education." Absolutely and irrevocably. This is the only basis on which dental education can advance sanely and constructively, and on which there should never develop anything like a lack of unanimity of opinion or policy.

In the president's address of Dean William F. Lasby of Minnesota, there was much food for thought. He called attention to the fact that the registration of dental students for the current year was lower than for any time in twenty years, that, in fact, from a maximum of 13,099 in 1922, there had been a yearly decrease to the low mark of 7,160 in 1934. This could not all be accounted for by economic conditions for the reason that, during the same period, there had been an increase in registration in most of the other institutions

of learning such as colleges of liberal arts, law, theology, pharmacy, engineering and medicine. He says:

> For several years, the schools of medicine in this country have been unable to accommodate the increasing number of fully prepared applicants who sought an opportunity to enter. Several hundred who failed to gain admission to a medical school in this country have gone abroad each year to study medicine. Schools of dentistry are conspicuous among professional schools and the institutions of higher learning in that they have shown a marked decrease in attendance. . . . Graduates in medicine are increasing the number of practitioners several times as fast as the population is increasing, while in dentistry the number of recent graduates scarcely equals the number who have discontinued practice.

To attempt to account for this would lead us into a discussion too far afield for us to consider at this time, but it may be intimated that while the character of the present curriculum may naturally be suspected of having something to do with it, the fact is that there are other influences at work with a deeper and more far-reaching significance that have a bearing on the situation. With these influences, we hope to deal in greater detail at some future date; but, on the present occasion, we must content ourselves with a brief further consideration of the curriculum study to the effect that the committee has proceeded wisely in emphasizing the fact that there is no assumption of finality in the report. In fact, the conservative attitude of the committee throughout is most commendable. Any attempt to force opinion at this time would be disastrous, and would lead to more harm than good. With a pioneer effort like this, there is especial need for the greatest caution and the utmost liberality of attitude.

We feel like congratulating the committee on their excellent effort, and we bespeak for them the support and sympathetic cooperation of all of those concerned in dental education.

TWO MEETINGS

Two meetings were held in immediate sequence in Chicago recently, the International Association for Dental Research, March 17-18, and the American Association of Dental Schools, March 19-21. As the second drew to its end, men were heard to say, "Epochal meetings, both of them."

The first was not that. Interesting in every detail as it was and

having some spots that sparkled, it contained nothing epochal. But a description that should fall only a little short of "epochal" would be that any onlooker might well indulge in pride and, if his memory were qualified, amazement. No epoch was marked, but progress, an amazing progress, was displayed.

It is not long since such a meeting might have been regarded as a far off dream. Research was new to dentistry and uncertain. Few men were fitted to carry it far. It was maintained only in widely scattered places. It had only scant allotments on programs and created no great interest. The men of those days deserve much for their faith, their persistence, their enthusiasm. Gradually the leaven worked and its influence spread. Teachers of all basic sciences were caught by it and those in the arts sensed a responsibility toward the subject. Fifteen years ago, only a few were able to talk in terms of the science laboratory, and often it was bemoaned that a gulf existed between those laboratories and the operator's chair. But that has changed. The laboratory man and the prosthetist meet and we may see two scientists.

Forty-six subjects were presented during the two days, to omit the business meeting of one night and seven general themes of the other. And those papers touched almost every dental problem. Questions that overlapped in the two fields of oral and systemic disease were analyzed by men equipped for the purpose. Dentist and physician and doctor of philosophy alternated on the program. And their method was that of the basic science laboratory. We would note that that, after all, is the observation of greatest importance. Dentistry has adopted and adopted understandingly the method of the fundamental sciences in its attack on its problems.

An important fact that one could not escape was the noticeable increase of group studies. It has long been known that this would help to check the wide systemic spread of oral conditions. "Would help to check" is used with consideration. One cannot miss the evidence that the great discoveries of history did not come about in this way. Newton, Pasteur, Koch, Black, Banting are proofs, if any are necessary. But, to use only one illustration, the anguish Banting often suffered might have been lessened if he had had cooperation. It seems clear that in any group procedure, the original

plan and final analysis devolve on the genius of one man. Likewise, one noted the presence of scholars in no way connected with organized dentistry who were deeply interested in dental physiology and dental disease. It came to mind that all the sciences were being levied on by dentistry as contributory to its domain.

To repeat: The meeting was not epochal in that a great discovery was disclosed, but rather it was a great meeting because in it dentistry was seen in attack on its entire front, using the only method possible to progress and success.

The second meeting might readily be regarded as epochal if one likes the word. It is difficult to descry an epochal event at its occurrence. Time gives place and importance to events. Looking back, the refusal of medicine to house dentistry seems epochal. The realization that dentistry contributed to ill health by its ill restorations might appear as a sign-post marking a change of route. The report of the Carnegie Corporation might be proclaimed a high spot in dental history. But all of these indicate periods too short to deserve the term epochal. Epochs connote greater lengths of time. The rapidity of these occurrences merely indicates the speed at which dentistry has developed. The 1934 meeting of the American Association of Dental Schools will merit historic mention because of the report of the committee appointed in 1930 to make a survey of the dental curriculum.

When the curriculum survey committee was appointed, it received instructions from the association as to the scope of its endeavor. Those instructions were: (1) to ascertain the modern requirements for dental health service; (2) to determine the knowledge and skill that should be possessed by the dentist; (3) to recommend a curriculum based upon such study and analysis which will adequately prepare the undergraduate for dental practice; (4) to include in that curriculum training in development of character, an appreciation of the humanities and a scientific outlook that will assure the graduate's interest in dental research.

The size and importance of the task outlined is imposing. To fit themselves, the committee sought to obtain a comprehensive view of the field. This was done by study of the dental literature and by ob-

taining the opinions of laymen, physicians, public health officials and dentists. On this basis, they drew up the objectives of dental education for their own guidance. How completely this was accomplished was evinced by the report.

In this consideration, it must be borne in mind that the labor of the committee was gratuitous, was given on call. And that meant hours that totaled days and weeks of toil, the only reward for which was the consciousness of duty done for the common weal of dentistry and those whom dentistry serves. Most of the names on committee and subcommittee will perhaps never appear in public print, but to them none-the-less must be ascribed the honor of a high devotion, the highest, in fact, because of that obscurity. By the same token, the highest esteem is ascribed to the man who directed them in thought and action. Were he not the man he is, they had not served so well.

The report of the committee was discussed with gravity and sometimes with intensity. There was unanimous approval of its worth, its thoroughness, its possibilities. Its applicability may be questioned in some detail, but its general validity was conceded. The vote for adoption stood thirty for and one against, with one school withholding its ballot.

Giving inspiration and strength to the meeting were addresses by internationally known educators. Drs. R. E. Scammon, G. A. Works, W. W. Charters, R. A. Kent and C. H. Judd gave to the rest a linkage with the world's program of learning. They integrated dental education with the general concept of education. Dental education is no longer a thing apart, but a part of the whole.

In considering the survey, it must not be forgotten that it was made possible by a gift from the Carnegie Corporation. The American Association of Dental Schools, the American Dental Association and American dentistry in all its parts acknowledges indebtedness for the money that made a dream of years a historic fact.

T.

HONOR IN THE ADVERTISING WORLD

In the April issue, we published an editorial on the inequity of advertising by professional men in the public prints, and now we

wish to discuss another angle to the question of advertising. In the previous editorial, we made the statement that "it may be perfectly legitimate for a business man to advertise his goods provided he does not misrepresent them." Here is precisely the rub. More and more, there is developing a sentiment in the business world to the effect that there must be honor in advertising. In the March 29 issue of *Printers' Ink,* there is an article by Edward L. Greene, general manager of the National Better Business Bureau, entitled "Decent Advertisers Must Take Lead."

And it is exactly this sentiment that is needed to purge advertising of certain of the questionable methods and practices in the past. It is a hopeful sign when the commercial interests begin to concern themselves with the purification of advertising. There may be a distinction in ethics between advertising on the part of professional men and advertising on the part of business men, but there is no ethical concept that will ever justify misrepresentation in advertising on the part of either business or the professions.

The public press, whether in the form of newspapers or magazines, should unite in placing the ban of disapproval on questionable advertising. The public is entitled to protection from imposition and injury in this respect, and this is especially pertinent when we consider the amount of harm that can be done and has been done through this medium. If this is true of lay publications, how much more so is it true when applied to our professional periodicals.

In our dental journals, especial care should be exercised to safeguard the welfare of the readers by excluding misleading or harmful advertising, and there should be a rather well-defined effort on the part of the reputable element among our publications to frown on any attempt to exploit the profession or the public through harmful methods.

On the other hand, in view of the fact that legitimate advertising is as honorable as any of the other enterprises of life, there should be an effort on the part of all concerned to encourage the use of those publications whose ethical concept may be relied on to conserve the welfare of their constituents. If reputable publications sacrifice income by excluding unworthy patronage (and this is freely done in all of our honorable publications), some encourage-

ment should be given to these publications in the nature of throwing legitimate advertising their way. If the publications sacrifice financial gain for a principle, they are assuredly entitled to the commendation of all honorable men, and there is no inequity in making a proper discrimination between worthy and unworthy publications when it comes to the support of the advertising interests. In other words, support should be given to those publications that stand for ethics not only in their printed pages, but in their advertising as well.

INSURANCE COMPANIES AND DENTAL AILMENTS

Dr. Millard D. Gibbs of Hot Springs, Ark., has called pointed attention at various times to the significance of mouth infection as it relates to the problem of life insurance. He argues that if dental diseases are as important as we have been claiming, there is no reason that examination for life insurance should not include an inspection of the conditions of the mouth and teeth. He has approached many of the higher officials of our life insurance companies, and they almost to a man are much impressed with the importance of the question; and we feel that it is only a matter of time when this idea will prevail and an examination of the teeth will be made routine in applying for a policy.

While we have not yet gone beyond the point of debatability as to the precise rôle played by pulpless teeth in the human economy, we at least know that the general condition of the mouth cannot be ignored as an influence on health and longevity, even if it is not in some instances a determining issue in life and death. Therefore, it would be quite logical for the companies to insist on an elimination of suspicious mouth conditions as a requisite for acceptance as a policy holder. The time and cost of such requirement could not be urged against this provision when its importance is once realized.

Reforms of this nature are usually slow of development, but as soon as the companies are made to recognize the essential significance of mouth conditions as regards the physical welfare of individuals they will not long be dilatory in instituting the necessary precaution in their examinations. The benefits to be obtained from

this procedure would far outweigh the slight inconvenience or cost.

The first company to inaugurate such a plan will not only to that extent conserve the welfare of its own organization, but it will also in unlimited measure receive the commendation and sympathetic cooperation of the dental profession.

TWO RESOLUTIONS

Two resolutions that have just come voluntarily to the Central Office of the Association are really significant; one from the District of Columbia Dental Society, and the other from the Cleveland Dental Society, the former having taken the initiative in this movement.

The resolutions run concurrently up to the last paragraph as follows:

WHEREAS, *The Journal of the American Dental Association* is the official organ of the Association and organized dentistry;

WHEREAS, the Advertising policy of *The Journal* is conducted on the highest standard for the benefit and protection of the dental profession and the public;

WHEREAS, the said *Journal* deserves the wholehearted and substantial support of every member of organized dentistry; and

WHEREAS, the Beneficial Circle Plan was created for the purpose of stimulating interest in and obtaining further financial support for *The Journal,* having as its ultimate aim the procurement of additional funds through the sale of legitimate advertising space to be used for the dental education of the public through the Bureau of Public Relations; be it

Resolved, that the Cleveland Dental Society (the District of Columbia Dental Society) urges its membership to consistently support the *Journal* in every way, and use and recommend the products of those firms advertising in the *Journal;* be it further

Resolved, that the Society records its approval of the Beneficial Circle Plan.

There is a slight difference in the last paragraphs of the two resolutions. The one from the Cleveland Society is as follows:

. . . and be it further

Resolved, that copies of this resolution be forwarded to the Officers and Trustees of the American Dental Association, to the Editor of *The Journal of the American Dental Association,* and to the Secretary of the Ohio State Dental Society for publication in the journal.

The wording of the District of Columbia final paragraph is as follows:

. . . and be it further

Resolved, that copies of this resolution be forwarded to the Officers and Trustees

of the American Dental Association, the secretaries of state and component dental associations, state society bulletins, and *Journal* advertisers.

Both of these resolutions were unanimously adopted by their respective bodies, and they connote a cooperative spirit that is very encouraging. One thing impresses us more and more, and that is the fact that the only thing necessary to gain wholehearted support for any worthy enterprise of this character in our Association is to have its intent and purpose perfectly understood by all of those most interested in the Association's welfare.

We congratulate these two component societies on their cooperative spirit. It augurs well for an extended sphere of usefulness among all of our branches, and tends to weld the entire body together.

WHEN THE EDITOR IS HELPLESS

As everyone is aware, or should be aware, THE JOURNAL does not reproduce material that is already in print. Therefore, when an author submits a manuscript for publication, it is taken for granted that the same manuscript has not been submitted elsewhere. It has happened several times of late that, without our knowledge, a paper in our possession has been sent to another publication. We have had the manuscript edited and set up by the printer, only to find, just before publication, that the paper has come out in another magazine.

Of course, we have at once been compelled to stop publication of the paper in THE JOURNAL and have the type killed, all of which is a serious loss in time, energy and money, to say nothing of the injustice and annoyance. We have repeatedly announced that we do not reproduce material from other periodicals nor do we publish simultaneously with other journals. If any one can make suggestions as to how this abuse may be stopped, we shall be grateful.

AT LEAST KEEP TIDY

Sometimes the difference between success and failure in professional life is measured in a certain sense by the way a man keeps his

shoes shined, or his hair cut, or his trousers pressed. To shave religiously every day is an asset. And the finger nails—oh, those finger nails of some dentists!—let us draw the curtain. It may not be possible to wear expensive clothes, or to have new ones very often, or to own a car; but the clothes may be neatly brushed and always clean, and if you have to ride in a street car, you can at least behave like a gentleman. Around the office—ah, that is the supreme test. Tidiness counts every inch of the way, and everyone can be tidy. If you have no janitor and no assistant, keep the office clean yourself, and do it early enough in the morning that no patients will catch you at it; but better let them catch you than to permit the office to go without cleaning—anything but that. You cannot maintain self respect in a dental office without cleanliness and a certain amount of order. Disorder and slovenliness have spelled the downfall of many an otherwise promising career. At least keep tidy.

Obituary

HENRY FOWLER

Following is, in part, a eulogy of Dr. Henry Fowler, who died recently at his home in New York City, written by a medical friend and associate, W. E. Aughinbaugh:

It was my great privilege to enjoy for approximately thirty years the friendship of Henry Fowler. I have been a physician for more than forty years. That has given me an opportunity to know men—to know them intimately, and I can truthfully say of Dr. Fowler that to few has it been given to mean so much to so many persons. His friends were legion and to each he gave an unusual measure of sympathy and consideration. Without great wealth, he gave liberally to those less fortunate. It was his custom, for example, each week to take inmates from the home for the aged for an automobile ride.

He despised the greed and the pettiness of men. He believed with his whole being in lending a helping hand to those in distress. He was as honest as the day is long.

Rich in the knowledge of his profession, he gave much to science, and his associates repeatedly honored him by electing him to offices of trust.

Despite the fact that he knew that he was doomed, he never faltered, never gave the slightest evidence of the great physical torture that he was enduring. Death had no terrors for him, although life was sweet and he hated to leave his friends.

He came as near to Wadsworth's definition of a true gentleman as anyone I have ever known, for he was as manly as a man and as gentle as a woman. As Ingersoll said at the funeral of his brother: "If each one for whom he had done some kindness during his life was to place a rose upon his bier, he would sleep tonight beneath a mountain of flowers."

PRACTICE IN PARAGRAPHS

This department is intended for busy readers. It aims to tell a vivid story in a few words. Items should be of a practical character, and free from padding—not more than a paragraph or two. We exact no limit, but two hundred words can tell most of these stories. Send in your ideas; they will be welcome.

Before Extracting Teeth—The gingival crevice between the gum and the tooth should be carefully cleaned with a pledget of cotton saturated with an antiseptic and passed around the neck of the tooth before extraction, to make sure that no infected material is forced into the tissues by the beaks of the forceps. This precaution may go a long way toward avoiding unnecessary soreness following the operation.—*Exodontist.*

Soldering Crowns or Bridges—Instead of cutting solder into small pieces, use a long strip of the solder, and, having the invested piece heated quite hot, feed the end of the strip to the desired place by holding the strip in the pliers and directing the flame of the blowpipe at the juncture of the strip and the invested piece. In this way the solder can be fed exactly where it is needed, and any kind of contour can be built up.—*J. W. J.*

Burning Palate—The cause of a burning palate has, ever since my college days, been attributed to the color of the vulcanite; and in wearing my early upper dentures, I was afflicted with a very annoying burning in the palate. In every case, I was advised by all the good denture men of my acquaintance to get a metal base. When I began making dentures without relieving the palate, I soon found that there was no burning from the dentures. Wax or anything else that will fill the space is placed between the palate of the denture and the palate of the mouth, and there is no more burning sensation under that denture. Kindly write me if this does not solve the problem.—*George H. Henderson, Chicago, Ill.*

Tin-and-Gold for Children's Teeth—No filling material yet suggested equals a combination of gold and tin foil for filling pit and fissure cavities in children's teeth. It can be inserted in less time than amalgam, and can thus be used without the rubber dam. It does not shrink or change form in any way. It does not discolor the tooth. It grows harder after insertion in the tooth. It never leaves the tooth sensitive to extremes of temperature. It can be condensed without the mallet. It is quite permanent in the indicated cases, and it should be used more generally than it is. It may be used half gold, half tin, number four foil rolled together and used in the form of ropes of convenient size.—*Ed.*

Pulp Amputation—The exposed vital pulp in the tooth of a child 12 years of age or younger is a serious problem. However, it is one of easy solution—pulp amputation. In the deciduous teeth, if the pulp is amputated at the floor of the pulp chamber, the root or roots will continue to be resorbed in a normal way. In the permanent teeth of children at such an age, the roots are yet undeveloped. After pulp amputation at the floor of the pulp chamber, the roots continue to grow, and there is seemingly normal development to the ends. Subsequently, in many cases, the pulp canals are completely obliterated to the place of amputation by the building in of osseous tissue. The application of arsenic and mummifying pastes is strongly condemned. Pulp wounds should be covered with a permanent dressing of zinc oxide and oil of cloves, followed by the desired filling.—*W. Clyde Davis, Lincoln, Nebr.*

Removing Compound From Impression Trays—It is sometimes difficult to keep new impression trays smooth and shiny, particularly if a knife or some other object is used to remove hard or sticky compound from the tray after use. Either of two methods may be employed for removing compound from trays without scarring them. After removal of the bulk of the compound by softening in hot water, the tray is dried and a liberal amount of vaseline is applied to the tray, which is then held over an open flame until the compound bubbles or boils, when the softened compound can be effectively wiped out of the tray with a soft cloth. If the compound is not entirely freed from the tray, another application of vaseline will be necessary. Another method: After the excess bulk of compound is removed from the tray, the latter is immersed in a jar of gasoline and allowed to soak for twenty-four hours. On removal from the gasoline, the tray may be wiped with a rag and washed with soap and water. It is sometimes necessary to return the tray to the gasoline bath for further soaking before all particles are removed. In no case is a knife to be used to remove particles, if the tray is to be kept smooth and free from scratches.—*Rex N. Douglas, Elkhart, Ind.*

A Handy and Effective Blowpipe—In any dental blowpipe yet invented, natural gas is nothing less than an abomination. To offset this fact an old "Prestolite" tank—one in a "mechanically sound" condition—can be had from any automobile junk yard for a dollar or two and exchanged at any wholesale auto supply dealer's for a tank full of acetylene gas. A few feet of stout rubber tubing of a size suitable to connect the outlet of tank, an acetylene blowpipe (which can usually be purchased at the same place as the full tank and the tubing) and a small wrench to handle the valve on the tank comprise the only other equipment needed. (There is no air hose or bellows to be used with this simple outfit.) After all are carefully made, the gas supply is turned on carefully, as the pressure in these tanks is enormous and, if turned on carelessly, will burst or blow off the tubing immediately. As flame obtained from this outfit is nonoxidizing, it is ideal for all laboratory operations. The gas is very inexpensive, and the initial cost of the entire outfit purchased in the manner described should not be more than $5 to $7.—*Arthur G. Smith, Peoria, Ill.*

COUNCIL ON DENTAL THERAPEUTICS

WONDRPAK—NOT ACCEPTABLE FOR A.D.R.

The following report on Wondrpak was adopted by the Council in the early part of 1933, whereupon it was sent to the firm for inspection in view of their cooperation in furnishing to the Council a statement of composition. Shortly thereafter, it was acknowledged by the firm, who advised that they would reply to the letter at a very early date, after they had carefully studied the report. No reply has been received from the firm, although fourteen months have passed. The following is, therefore, presented for the information of the dental profession.

SAMUEL M. GORDON, *Secretary.*

Inquiries have come to the Council concerning Wondrpak (Westward Dental Products Co., San Francisco, Calif.).

The product sold under the name Wondrpak was introduced about ten years ago, by A. W. Ward, D.D.S., of San Francisco, for use in the radical surgical treatment of pyorrhea. As time went on, the composition of Dr. Ward's formula changed and the claims for usefulness were extended until the whole field of dentistry was included. It is now advertised for use in connection with surgical treatment of pyorrhea, extractions, dry socket, hemorrhage control, Vincent's infection, immediate dentures, temporary rebasing, impression taking, scaling, temporary filling, cementing and crowns.

This discussion will be confined to the product sold at various times as Wondrpak, remarks bearing on the method introduced by Dr. Ward for surgical treatment of pyorrhea being incidental to discussion of the product.

Under certain conditions, advanced cases of pyorrhea which cannot be treated by the conservative methods of subgingival curettement are treated by the so-called radical surgical method. This method, while known for a number of years, attained its greatest use after the demonstrations of Arthur D. Black. Dr. Ward follows an even more radical technic than that proposed by Dr. Black. Instead of operating around a few teeth at a time, Dr. Ward advises that the whole mouth be operated on at once. The removal of an extensive amount of hard and soft tissue required by Dr. Ward's procedure calls for some protection of the exposed surfaces of the root in the post-operative stages. The more conservative surgical treatment does not necessarily call for support. Consequently, Dr. Ward, in 1923, devised a quick-setting pack to be used instead of iodoform gauze and other surgical packs such as beeswax, beeswax and sticky wax and oxyphosphate of zinc. The ingredients of the pack are mixed like cement and forced into place under pressure. The tissues are said to regenerate under the pack, which is allowed to remain from four to six days after the operation. In later articles and in advertising, it is stated that it is kept in place from ten to fourteen days. He claimed that the packing works wonders; from which it probably gets its undignified name.

The liquid portion of the pack was, in 1923, said to be composed of olive oil and oil of cloves, equal parts, and "septol," 24 drops to the ounce. (The composition of septol is not known.) The powder was said to be composed of zinc oxide and white resin, the quantities not being given.[1]

1. Ward, A. W.: Inharmonious Cusp as a Factor in Periodontoclasia, J.A.D.A., 10:471 (June) 1923.

Dr. Ward has published two other papers in THE JOURNAL.[2] In the 1929 article, Dr. Ward mentions the product by the name of "Wondrpak" for the first time.

According to Merritt,[3] the qualitative composition of Wondrpak, from the "formula" furnished him by Dr. Ward in 1928, is: powder: zinc oxide, magnesium oxide and resin; liquid; oil of cloves, olive oil, leptinol and scarlet red. Leptinol is an alcohol of undetermined constitution from the plant *Leptotaenia dissecta*.[4] (It was included presumably because of its antiseptic properties, but evidence of its usefulness is not available.)

An article by Crane and Kaplan[5] also describing a radical surgical treatment for pyorrhea, carries the following formula for a cement pack:

> A very satisfactory cement is made by mixing a powder composed of equal parts of oxide of zinc and finely bolted powdered resin with a liquid composed of equal parts of eugenol and heavy mineral oil. It is well to have the cement mixed about one-half hour before it is intended to be used. When applied it should be quite firm in consistency and reasonably sticky.

Goodfriend[6] mentions a medicinal pack composed of zinc oxide, oil of cloves and balsam of Peru and used by him for nine years.

In the early part of 1931, inquiry was made of the Westward Dental Products Company, manufacturers and distributors of Wondrpak, regarding the composition. The firm readily complied with the request of the A.D.A. Bureau of Chemistry. The following was submitted:

Zinc Oxide	70%	Oil of Cloves	80%
Powdered Resin	30%	Olive Oil	20%
Asbestos	0.625%	Aniline Red Oil (Soluble)	100 of 1% Trace

(A specimen of Wondrpak was later examined in the Laboratory for asbestos. Four determinations yielded acid insoluble material (asbestos) 0.16 per cent, instead of the 0.625 per cent claimed. The firm stated that the amount of asbestos was so small that the formula was being submitted as 100+.)

Dentists who wrote to the Council or to the A.D.A. Bureau of Chemistry for the composition of Wondrpak were given this formula.

In July, 1932, there was referred to the Council a letter addressed to THE JOURNAL in which the manufacturers and distributors of Wondrpak stated:

> It has been brought to our attention that the formula of Wondrpak was published in connection with several articles written concerning its uses.
>
> You are hereby notified that Wondrpak is a registered formula covered by Patent No. 1866433, and that the publication of this formula is a violation of our patent rights.
>
> This notice is sent to all publishers of dental journals as a request to refrain from further publication of the Wondrpak formula.
>
> Kindly acknowledge receipt of this letter.
>
> (End of letter)

The receipt of this letter was acknowledged by the A.D.A. Bureau of Chemistry. Sensing that the request contained in that letter was not in the broadest interests of the dental profession or of the public, the firm was advised that the Bureau of Chemistry had given the composition of Wondrpak as submitted by the manufacturer to correspondents who had inquired concerning it. The firm was further advised that if they had informed the Bureau that the formula was to be kept confidential when it was submitted, it would have been returned to them. The Bureau and the Council do not desire

2. Ward, A. W.: Surgical Eradication of Pyorrhea, J.A.D.A., 15:2146 (Nov.) 1928; Postoperative Care in Surgical Treatment of Pyorrhea, ibid., 16:635 (April) 1929.

3. Merritt, A. H.: Periodontal Diseases, New York: Macmillan Company, 1930, p. 135.

4. Chemical Abstracts, 19:3351, 1925.

5. Crane, A. B., and Kaplan, Harry: Crane-Kaplan Operation for Prompt Elimination of Pyorrhea Alveolaris, D. Cosmos, 73:643 (July) 1931.

6. Goodfriend, S. J.: Am. D. Surgeon, 51:313 (Dec.) 1931.

information for themselves, but for the dental profession and the public. The firm was also advised that the Bureau was not aware that patent rights were being violated by the publication of information from Letters Patent. Letters Patent are accorded by the Bureau and the Council the same status as other scientific published material. It would be contrary to a generally accepted position if any restrictions were placed on the publication of the "formula," because it is not only the right but also the duty of the practitioner to know the exact composition as far as possible of what he is asked to use or prescribe.

It would appear, from a study of Patent No. 1,866,433, issued to Abraham W. Ward for "Surgical and Dental Pack Compositions and Method of Applying the Same," that the composition of Wondrpak has again changed and that wide latitude for the composition of the product, both quantitatively and qualitatively, is claimed. In other words, according to the patent claims, the inventor has a virtual monopoly on mixtures of the ingredients listed in this patent. However, patents are open to question and are not valid until passed upon by the courts. The natural gums that may be used were expressed as "gum damar, gum copal, gum kauri, gum Manilla, etc.," but A. W. Ward preferred to employ gum resin obtained from the exudate of pine trees (resin or colophony described in U.S.P. X). The preferable parts are approximately 2 parts of zinc oxide to 1 part of resin. To 16 ounces of this, 1 ounce of asbestos fiber in finely divided and in nearly powdered condition is added. Therefore, on this basis, Wondrpak powder may have the following essential composition: zinc oxide, 63 parts; resin, 31 parts, and asbestos, finely divided, 6 parts.

The composition of the liquid mass, may, according to the patent, be variable. It comprises a solvent for the resin, such as oil of cloves, oil of juniper berry, cinnamon oil, oil of wintergreen, turpentine and the like, mixed with a material capable of delaying the setting time of the cement. The material which may be employed for this purpose is again variable: a vegetable oil such as olive oil, cotton seed oil, China nut oil, peanut oil or linseed oil, or combinations thereof. Turpentine may also be used. An aniline dye may also be added. Scarlet red is preferred to the extent of from 0.5 to 1 per cent.

Information regarding the composition is given in detail to make clear that a proprietary, undignified trade name inexpressive of the composition has been applied to a mixture of well-known substances and sold for use in the treatment of dental disease and other dental manipulations. While the exact composition has been changed and may again change, the name remains the same. In general, it represents nothing more than a "prescription" to which proprietary rights have been applied. The Council holds that such prescriptions should be given freely to the profession, to be purchased from whatever source it may like.

The Council could not accept a proprietary name for a mixture of well-known drugs. To do so would be contrary to the interests of the profession. Such acceptance would penalize dentists by tending to inhibit further trial with various mixtures composed of these official products. The Council holds that the granting of patent rights to such a mixture of well-known substances is another instance of the abuses to which the patent laws of this country may be subjected.

It is immaterial whether a dentist uses this as a packing after surgical treatment of pyorrhea, conservative or radical, or for prosthetic work. The quantitative formula should be available on the label. The product is thus being marketed to dentists in conflict with Rules 1 and 8, regarding composition of products and proprietary names of mixtures.

Wondrpak is advertised to be used in connection with extractions and dry sockets. No evidence is available to the referee as to the advantages of a cement of this composition after extraction or for dry socket. No evidence is available that the product sold as Wondrpak is a "splendid aid in the treatment of Vincent's angina or trench mouth, seal-

ing the ulcerated surfaces from contact with infectious and irritating substances and acting as a constant antiseptic, sedative treatment," beyond the methods generally accepted and practiced today.

In view of the foregoing, Wondrpak is declared inadmissible to Accepted Dental Remedies (1) because it is a mixture of well-known substances sold under a proprietary name noninforming of composition, (2) the label does not bear a quantitative statement of composition, (3) the name implies unwarranted therapeutic claims and (4) claims unsupported by adequate evidence are made.

The present policy of the firm is such as to deny to the profession a statement of composition concerning the product. The Council cannot consider the admission to Accepted Dental Remedies of the product under a proprietary name until it is shown that the marketing of a mixture of the well-known substances in Wondrpak in definite, fixed proportions is in the interests of the dental profession. The marketing of this product in fixed proportions indicates that enough study has been undertaken that such a combination in fixed proportions is good for all the conditions recommended in the advertising; whereas, such is not the case. The composition of Wondrpak is such that it can be filled on the dentist's order by any properly equipped pharmacist.

The Council stands ready to consider marketed mixtures of zinc oxide, resin and asbestos and olive oil and oil of cloves when sold under properly descriptive names and with claims that do not go beyond reasonable evidence.

BEACON ABRASIVE GUM—NOT ACCEPTABLE FOR A.D.R.

The Council has authorized publication of the following report.

SAMUEL M. GORDON, *Secretary.*

Beacon Abrasive Gum, according to the Beacon Scientific Company, New York, is composed of 2.25 per cent carborundum, 24.75 per cent resinous gum and chicle base corn syrup and oil of peppermint, and 73 per cent pure cane sugar. It is said by the manufacturers to be "invaluable as on occasional means of equalizing the wear of different occlusal substances such as metal, porcelain and enamel."

Advertising sent to dentists states:

Dr. Sidney Sorrin, Assistant Professor of Periodontia, N. Y. University College of Dentistry, in a paper published in the June *Dental Items of Interest, says,* "In checking the coordination of the occlusion after putting in a restoration, to remove additional high spots or rough surfaces after grinding, incorporate carborundum paste with softened chewing gum."

The article, "Traumatic Occlusion" in the June, 1931, issue of *Dental Items of Interest* was examined and this statement was not found. The manufacturers were requested to give an exact reference to the source of this statement. A reply was sent from an advertising agency, which enclosed clipped pages of the article from *Dental Items of Interest* already referred to above, with portions marked. Within the marked portions, the following was stated as one of a number of suggestions for final checking up in cases of traumatic occlusion: "To remove additional high spots, or rough surfaces, after grinding, incorporate carborundum paste into softened chewing gum." It therefore appears that the suggestion of limited usefulness was changed about in such a way as to suggest the use of this preparation in all cases of restoration, a meaning apparently not intended by the writer of the article from which the reference was presumably taken.

In order to determine what usefulness such a preparation might have in traumatic occlusion, operators who are especially interested in peridental involvements that might be the result of traumatic occlusion were questioned. It was their opinion that such a

preparation would be of little value except to those who are manufacturing it. It is probable that such a preparation would have a slight value to others under certain conditions, but the harm that could come from its use without full understanding of where it was indicated, if ever, would possibly be much greater than any good that could possibly come from it. Grinding of the teeth or the application of any abrasive to them must be under the immediate supervision and control of the dental operator.

The Council cannot admit Beacon Abrasive Gum to Accepted Dental Remedies because its use has not been shown to be sufficiently established to warrant the general application of a hard substance such as carborundum to teeth and because the use of an abrasive such as carborundum away from the dental office could not be considered to be without harm.

SILV-O-DENT—NOT ACCEPTABLE FOR A.D.R.

The Council has authorized publication of the following report.

SAMUEL M. GORDON, *Secretary.*

Silvo-O-Dent, manufactured by the Silv-O-Dent Company, Portland, Ore., has been on the market for a number of years. Silv-O-Dent is sold for use as a pulp protector against thermal changes and as a preventive of decay, and for capping pulps. The composition is now stated as "Processed zinc oxide and silver salt in the powder, and eugenol with thymol and oleoresins in the liquid."

A request for the quantitative composition of the product was sent to the manufacturer on two occasions, in the early part of 1929, and in the middle of 1932. On each of these occasions, Harry B. Garrison, D.D.S., writing for the firm, did not divulge the composition of the product, but made special pleas for secrecy of composition. The firm was advised that it is not only the duty, but also the right, of the dentist to know the composition of what he is asked to use or recommend. Meanwhile, a number of inquiries concerning the product had been received from members of the dental profession. Hence, it was examined in the A.D.A. Bureau of Chemistry.

The Chemist's report, appended below, concludes that the liquid part of Silv-O-Dent is essentially eugenol, U.S.P., and the powder is essentially a mixture of zinc oxide, 97.5 per cent, and silver proteinate, 2.5 per cent (probably strong silver protein, U.S.P.)

In the booklet "Silv-O-Dent Technique," the following claims are made:

> You have nothing in your dental pharmacopoeia that will soothe the throbbing, irritated pulp more quickly than a dressing of Silv-O-Dent. No cavity can be sterilized with bur or excavator. Rely on Silv-O-Dent. The silver, thymol and eugenol content positively inhibit and sterilize.

From the foregoing, it is apparent that the first statement is a misstatement, for Silv-O-Dent contains, according to the examination, well-known pharmacopeial material. To rely on sterilization of a cavity with Silv-O-Dent, in place of attempting to remove the débris as nearly as possible by operative means, is not in accord with sane dental practice. The rest of the material in the booklet on the"Silv-O-Dent Technique" contains much that can be found in most textbooks on operative procedure, the emphasis being placed on the use of Silv-O-Dent in place of the many other combinations suggested for capping exposed pulp.

The promoter of Silv-O-Dent is more optimistic regarding the saving of exposed pulps than are conservative dentists. The evidence on which this optimism is based is not available; whereas, the experiences of many who have studied the problem are fully published and available in the literature.

No evidence is available that Silv-O-Dent is the superior or that it is even the equal of zinc oxide and eugenol for the purposes recommended. It must be borne in mind that the obtaining of sterile operative areas depends not so much on the medicaments used as on obtaining sterilization and cleanliness before the application of a bland protective covering.

The name Silv-O-Dent gives no indication of the composition of the product. In view of the secrecy of formula, it is possible that the composition of the product may be changed at the will of the promoter. There are a number of preparations of known composition available for pulp capping and for temporary linings. These are too well-known to require comment at this place, since they may be found in most textbooks on operative dentistry.

In view of the foregoing, Silv-O-Dent is declared inadmissible to A.D.R., because the composition is secret (Rule 1); tests to show the constancy of the composition are not made available (Rule 2); the name is not indicative of the chemical composition of the product (Rule 8), and no evidence has been made available that Silv-O-Dent possesses any advantages over zinc oxide or eugenol for the purposes for which it is marketed.

The Chemist's report follows:

Four (4) original packages of Silv-O-Dent (The Silv-O-Dent Company, Portland, Ore.), price, $2.50 each, were purchased for examination.

Each package contained a bottle of solid material and a bottle of liquid.

The following appeared on the carton:

An oxy-eugenol silver pulp protector.

The following appears in advertising concerning the preparation:

The formula: Processed zinc oxide and silver salt in the powder and Eugenol, with thymol and oleo-resins in the liquid, has been perfected during fifteen years of active practice by the writer.

LIQUID

Each bottle of liquid contained 8.7 c.c. (approximately 0.3 fluid ounces) of a light yellow liquid with an odor of oil of cloves. The density at 25 C. was 1.076; the refractive index at 20 C. was 1.5406. The density of eugenol, U.S.P. is from 1.064 to 1.070 at 25 C.; the refractive index of eugenol is from 1.541 to 1.542 at 20 C. (Gildermeister and Hoffmann, Die Aetherische Oele, I:509).

When 10 c.c. of the liquid was subjected to distillation, 9.2 c.c. of a colorless liquid distilled over in the range 246-250 (uncorrected). A similar amount of eugenol U.S.P. distilled in the same range.

The following tests were carried out: 1 c.c. of Silv-O-Dent was shaken with 20 c.c. of water, and filtered. Five cubic centimeters of the filtrate was treated with 1 drop of ferric chloride test solution. A transient grayish-green forms. Eugenol U.S.P. was treated similarly, and the same results noted.

One cubic centimeter of Silv-O-Dent was treated with 12 c.c. of sodium hydroxide, T.S., and 19 c.c. of distilled water. A clear solution results. Eugenol U.S.P. reacts similarly.

From the foregoing, it may be concluded that Silv-O-Dent liquid is essentially similar to Eugenol, U.S.P.

SOLID

Each bottle contained 12.5 gm. (approximately two-fifths ounce). The contents of four bottles were bulked and mixed. The powder had a flat, white appearance suggestive of zinc oxide.

Qualitative tests indicated the presence of zinc (as zinc oxide) and silver in combination with protein material. When a small amount of powder is treated with water, dark brown specks appear interspersed throughout the mixture.

Quantitative determination yielded the following:

Loss in weight (135 C.)	0.22 per cent
Ash (300 C.)	98.11 per cent
Zinc oxide, U.S.P. (Before ignition)	97.8 per cent
Zinc oxide, U.S.P. (After ignition)	99.7 per cent
Silver	0.21 per cent

Assuming that the silver is present in the form of a strong silver protein, U.S.P., it may be concluded from the foregoing that a mixture essentially similar to Silv-O-Dent may be made by mixing together 97.5 parts by weight of zinc oxide, U.S.P., and 2.5 parts by weight of strong silver protein, U.S.P.

(End of chemist's report.)

The price of eugenol and zinc-oxide, silver proteinate mixture, when purchased as Silv-O-Dent, is thus seen to be far out of proportion to the actual cost of the ingredients. One pound of chemically pure zinc oxide can be purchased for approximately 60 cents at chemical supply houses. Eugenol, U.S.P., can be purchased for 42 cents an ounce.

BUREAU OF PUBLIC RELATIONS

SOME ASPECTS OF TEACHING MOUTH HYGIENE TO CHILDREN*

By GLADYS EYRICH, Jackson, Miss.

TWELVE years ago this month, at the 1921 A.D.A. meeting in Milwaukee, there appeared on the program of the Mouth Hygiene and Preventive Dentistry Section a teacher of physical education. The story she told was of securing 100 per cent dental corrections, attested by certificates from dentists, for 1,674 pupils in six elementary schools. It was a novel story at the time, not only because of the 100 per cent corrections, but also because there was no money to back the program, the parents paying for all work except for a small number of children for whom the dentists worked without cost.

This program had been built up gradually over a period of several years. That particular year, the 100 per cent was achieved after it was discovered that one school scored 50 per cent at the time of the inspection. A spirit of competition was built up among the schools: a star was given each child with a certificate, half holidays were declared for 100 per cent rooms, and parades with banners, picture shows, parties, ice cream cones, pictures in the paper, all fell to the happy lot of the school reaching 100 per cent. The children and parents alike became interested in mouth health, an increasing number visiting dentists each fall before school opened. They brushed their teeth with some regularity, usually remembering to do so on the night preceding the day when the supervisor paid their school a visit, for she never forgot to ask them. They drank milk too, in order to raise their weight and exchange the red card ("card of red, danger ahead") for "card of blue." Although this card read "card of blue won't do," it was better than the red one, and the "card of white, all right" stood out as the ultimate goal, for it meant that you were not more than one pound under weight nor more than 20 per cent over the weight which was termed "normal."

There were lovely stories, too, accompanying these efforts: one about a little prince who had some pearl houses he would not care for and the other who cared for his houses, and, in the end, if you were 6 years old, the prince turned out to be you and the houses were your teeth, and from that you learned always to "brush your teeth to keep them sound, up and down and round and round." And there were lovely fairies in the milk: Sally Sugar, Vera Vitamin, Polly Protein, Minnie Mineral, Fanny Fat, and you, being 6, still had some of the urges of the cannibal, so you ate or drank them all and they painted your cheeks red and

*Read at the Seventy-Fifth Annual Session of the American Dental Association in conjunction with the Chicago Centennial Dental Congress, Aug. 11, 1933.

your teeth white and you were beautiful and well.

It sounds pretty crude, even for twelve years ago, yet similar teaching procedure is still widespread. The milk fairies and the little rhymed weight cards disappeared even before growth charts supplanted age-height-weight tables; but mouth hygiene teaching seems to lend itself easily to the realms of dreams and fantasy, to charts and honor rolls, to banners, certificates, stars, slogans and parades. Apparently, we who are limiting our health work to the field of mouth hygiene are better satisfied with this type of teaching than are those who study and interpret health education in all its phases.

It is not the purpose of this paper to condemn this mode of teaching entirely, nor to propose any original ideas. The purpose is rather to provoke serious scrutiny of present procedure; to arouse dissatisfaction with that which we may profitably abandon, and to stimulate the development of mouth hygiene lessons based upon sounder teaching psychology.

There are two tests which may be applied to mouth hygiene teaching: 1. What results is it producing? 2. Does it measure up to standards set by recognized authorities in health education?

In reply to the first question: The spread of mouth hygiene activities all over the world, but particularly in our own nation, is an indication that the teaching has been effective. Important among the many signposts of growth are the city, county and state bureaus or divisions of mouth hygiene, some of them growing out of such beginnings as the one described. While these departments are a source of satisfaction because they are in part a result of mouth hygiene teaching, they are also a definite challenge, since they so greatly augment the power available for teaching.

Of greater significance as a measure of effectiveness are the results these departments are securing. Results are difficult to measure, since mouth hygiene is being carried on in association with other equally important health activities, and assistance is given mouth hygiene programs not only by departments of health and education, of which it is a part, but also by welfare and civic organizations. Again, to measure it accurately would be to apply the measuring stick to the changes in habits, attitudes and knowledge concerning mouth hygiene on the part of all who are touched by the program.

From sixteen answers to a brief questionnaire sent to twenty-two directors last fall, it seems evident that mouth hygiene has achieved both positive and negative results. Unfortunately, it is impossible to give more than a hint of the many worth-while accomplishments of these various programs, but it is apparent that the positive results outweigh the negative. But that there are potential positive results which have never been developed is likewise true.

In reply to the question, "What has been accomplished in your state in the past ten years?" the answers include both measurable and unmeasurable results. Several illustrations of the positive measurable results are given here. Pennsylvania has 400 school districts with definite educational preventive dental hygiene programs, fifteen districts having inaugurated the service this year. Alabama, through four years' statistical examination of teachers at summer normals, finds a reduction of dental defects from five to three and one-tenth. Over a period of three years, among the 500,000 elementary school pupils in Massachusetts, there was a rise in dental certificates from 4 to 21 per cent; in Minneapolis, 89.8 per cent of 55,000 school children visit their own dentists;

in Iowa, 167 schools reached 100 per cent in dental corrections between September, 1932, and February, 1933; in Mississippi, 23 per cent of 3,443 children having 100 per cent corrections in 1923 rose to 40 per cent of 105,000 in 1932; in Bibbs County, Georgia, the number visiting the dentists almost quadrupled in a three-year period.

These percentages are interesting in the light of the fact that the Commonwealth Fund in its appraisal form has set as a standard for dental corrections that 15 per cent of the grade population have teeth filled or extracted each year, and further that 75 per cent of children in grade one and grade six visit the dentist during the year. In Lauderdale, one of the two counties in Mississippi where the fund operates, there are 5,741 white and 4,223 negro children in grades one to eight, making the quota for teeth filled or extracted 1,500. The number having this service was 5,340. In grades one and six, there are 1,574 white and 1,699 negro pupils, making the quota for those visiting the dentist 2,349. The number with corrections complete was 1,216. This means that the white enrollment was nearly 100 per cent, since few of the negroes visit the dentist.

While such standards must be somewhat arbitrary, it is suggestive that a simple appraisal form for mouth hygiene programs might be worked out to aid in measuring the effectiveness of activities among children of preschool and school age. Since all programs are endeavoring to reach the preschool group, in the absence of state-wide figures, results from Jackson, Miss., are given. The county hygienist attends all preschool conferences, examines and cleans teeth and talks with parents. A comparison of two years work at preschool conferences in the Poindexter district is shown in the accompanying table.

While this is only one of the districts in which these conferences will be held, we have reason to believe that the others will show improvement since public health is the first consideration of parents in Jackson. A questionnaire bearing on thirteen activities pertaining to the school system was sent out by the Jackson education association to 5,000 parents. From 2,500 replies, it was found that public health, health education and progress and achievement of pupils are the three phases of school work in which parents are most interested. The work in mouth hygiene, starting in school inspections twenty years ago, growing later into the 100 per cent school program already described, then into the establishment of state and county health departments, is doubtless a factor in creating this health interest.

COMPARISON OF TWO YEARS' WORK

Year	Examined	OK	Per Cent OK	Visiting Dentist	Pupils Having Teeth Cleaned by Hygienist
1932	38	14	37	6	34
1933	75	43	57	29	60

Negative results or "the holes" in our programs are revealed by another question asked these directors: "What do you consider your greatest present needs in making the teaching of mouth hygiene more effective?"

The predominant needs stated are: money, sometimes given in terms of more workers; teachers better trained and more cooperative; dental health education of the dentist. Other needs mentioned by several are: a recognition of the seriousness of dental defects on the part of health departments and health workers; remedial service for fees parents can afford to pay and dental service for those far removed from a dentist.

It is significant that only two directors give that side of the picture; which may be in part the cause of the negative re-

sponse from teachers, one of them stating the greatest needs thus: better material for teachers; better use of what material we have; better understanding of health motivation by teachers, nurses, hygienists and dentists; more consulting service in health education for the classroom teacher.

This brings us to the second question under consideration: "Does mouth hygiene teaching measure up to standards set by recognized authorities in health education?" Those of us teaching or directing mouth hygiene programs expect a great deal of the teacher. We think she should be an example of the benefits of mouth hygiene, an enthusiastic exponent of its advantages, an intelligent teacher of its essentials. She has a right to expect that we shall have specific objectives, that we shall be scientifically accurate and educationally sound. These minimum standards are in accord with the Joint Report of the Committee of the National Educational Association and the American Medical Association, the White House Conference, the conferences of health workers called by the American Child Health Association and the writings of those who lead in such gatherings.

Present-day health teaching considers the whole child and so must we. Health education is defined by Thomas D. Wood as "the sum of experiences in school and elsewhere which favorably influence habits, attitudes and knowledge relating to individual, community, and racial life." In the light of this definition, "a better mouth for every child," which might have expressed the aim of the teaching done a dozen years ago, becomes "a clean, healthy mouth for every child, with the desire to maintain it in that condition, knowledge of how it may be done and habits formed to that end." With this aim in mind, we might alter some of our procedures, for instance, dental inspection, increasing its educational value; for if the inspection is made merely for information and correction of dental defects, it has no place in the school program. Teachers have been justly critical of such attitudes in our work.

A large field of scientific facts has opened up in the past decade through research in dentistry and in nutrition. As the channels through which health information is disseminated have likewise multiplied, it becomes necessary that specialists in mouth hygiene be able to recognize assured health facts, near facts and assured health fallacies, as related to their subject at least, and be able to guide teachers and pupils in their evaluation of current statements. W. R. Davis ably discussed this and other important points in "The Great Need for Dental Health Education."

To be educationally sound, the lessons should be positive, adapted to the group in grade level and environmental needs, interesting to children as children and developed according to the laws of habit formation.

Positive teaching is not only best psychologically but is also good health practice. It avoids the use of the fear element, once popular in health instruction and places the emphasis on what to do.

An analysis of "Health Behavior" by Wood and Lerrigo and of courses of study based on this book will give the teacher of mouth hygiene help regarding the habits, attitudes and facts which should be taught at the different grade levels; while a study of the children and the conditions of their living will determine what health teaching is practical.

If the lessons are interesting to children as children, false motivation, rewards, undue praise and competition will be unnecessary, health education teachers

tell us. The White House Conference Preliminary Report says, in describing the adequate school curriculum:

> Recent trends in health education place emphasis on health behavior as the main goal of teaching. Practice rather than theory should be emphasized in the training and instruction of children of elementary school age. There is cause for grave doubt as to whether most devices enlist either a desirable or a lasting child interest. The child should be led to find satisfaction in his own activities rather than in inducements provided through point systems, prizes or awards.

Although the success of the mouth hygiene program is based upon the formation of habits, we teachers of mouth hygiene have been unable to carry out in large measure the laws of habit formation. We may launch the teaching of the habit with enthusiasm, but the odds are against us that the act will be repeated at the next opportunity, that no exceptions will occur and that pleasure will be associated with the performance and satisfaction derived therefrom. We fail not only because we cannot arrange to reproduce the life situation, but also because the habit which we are attempting to instil probably should be broken up into many specific habits until the child acquires the skill which will be a favorable factor in developing satisfaction associated with the performance. Strang brings out the fact that, in cleaning the teeth, there are a dozen motor habits involved, and that the admonition "Clean the teeth at least twice daily" is educationally inadequate. Those who have taught a tiny child or the blind to brush the teeth realize how difficult is an adequate performance. The danger is in attempting too much learning at one time introducing one step before the preceding step is mastered.

It follows that if we believe in being scientifically accurate and educationally sound, the materials and activities which we suggest for teaching purposes will conform to the same standards. The two chief difficulties are (1) that our materials make use of the unreal in fantasies, dreams and personification of inanimate objects, and (2) that our activities depend too largely on the bestowal of awards.

Dr. Strang says, in "Principles and Practices in Health Education": "While extrinsic incentives may be expedient at certain times and under certain conditions, they are not, in the long run, educationally justifiable or efficient. The effort should be made to build health interest through participation in natural and enjoyable school activities." Some incentives which rank high in the scale arranged by Dr. Strang are:

1. Knowledge of results (which children are achieving according to dental inspection, progress in habits of eating, caring for teeth).
2. Praise that is specific, spontaneous, objective and deserved (rather than praise which is used consciously by adults to affect behavior).
3. Rewards which any one who puts forth sufficient effort can attain (avoiding those which only a few can attain and also those which encourage falsification).

Since even our textbooks leave much to be desired in the material on mouth hygiene, the following criteria gleaned from several sources including health education classes are given as suggestions for examining textbooks, commercial material, stories, songs, rhymes, plays, posters and films:

1. Does the material contain accurate information? No information should be given to a child until the scientific accuracy is established.
2. Who is the author of the material? Has he the background for writing it? What is the object in writing it? Does

it tend to overemphasize one phase of mouth hygiene or the use of a certain product?

3. Is it in accord with modern good educational theory and practice?

4. Is it well motivated? Is the motivation sound? That is, is it placed within the subject itself? Is it likely to function productively in adult life? Motivation by giving rewards is unsound if judged by these two standards.

5. Is it suited to the intelligence level and related to the common experiences of the children for whom it is used?

6. Does it have literary (or artistic) merit?

7. Is it positive? Does it provide for derivation of satisfaction from the right conduct rather than from dissatisfaction with the wrong? Does it respect the child's wish for security by avoiding use of the fear element, a negative procedure?

8. Does it provide for situations or activities in which the child may learn by doing?

9. Does it provide satisfaction in any way for things the children have done?

10. Do the activities presented lead the children to larger fields of activity?

11. Does it provide for a use of materials at hand and as they occur in life?

12. Is it real? Since the goal of health teaching is to establish desirable habits and attitudes, experiences and situations based upon reality should be used rather than phantasies or dreams. The latter may entertain but do not suggest adventures into which the child may enter vicariously and which he can translate into his own health behavior.

Judged by these standards, particularly the one of educational soundness, is there an abundance of good mouth hygiene material for teachers? No, not ready made. There is abundant source material for health teaching, but it is not often available to teachers; nor do many of them have the time or talent to assemble and utilize it to create situations through which the child may learn mouth hygiene. It is for this reason that state departments of health have published mouth hygiene material for teachers.

The character of this material has changed gradually in the past few years. Fewer posters are printed, and when they do appear, the illustrations are usually photographs or drawings of children in scenes from real life. State departments probably all agree with the White House Conference that: "The poster of greatest educational value in presenting mouth hygiene to a child is the one in the creation of which the child has an active part. Such posters are usually crude in execution, but much more valuable as a means of teaching."

This can be said also of dramatizations; and, for the same reason, the most valuable films are those made locally. Alabama and Pennsylvania have their own mouth hygiene films, and Mississippi has some motion pictures of health activities, including mouth hygiene.

The recent bulletins are usually brief and often attractively illustrated with photographs of children. Instead of issuing separate fliers, Massachusetts is now adding suggestions on care of teeth to general health literature.

Several state departments have abandoned the distribution of stories, songs, rhymes and plays. Lectures to large groups, especially to children, are less frequent than classroom instruction, and the opinion is that this instruction can be given best by the grade teachers instead of the health specialist visiting for a brief period.

With the ideals and pitfalls of health education fresh in mind, a booklet, "Suggestions for Teachers," was arranged last summer by Georgia and Mississippi supervisors working together. An aim

and general objectives were set forth, and specific objectives for each two grades. Habit, attitude and knowledge levels were guided by "Health Behavior," by Wood and Lerrigo; the Baltimore Course of Study furnished some of the ideas for the problems, activities and references. Care was taken to suggest only real situations for teaching; to make the booklet brief, emphasizing fundamentals; to use poetry with health implications rather than rhymes about teeth, to have illustrations representing children, adults, foods and toothbrushes instead of fairies and gnomes; to use as suggestions for plays incidents which may conceivably fall within the child's experience.

A booklet of this type will answer the teacher's needs better when we can incorporate into it some projects developed by teachers who have used it. To bring this about, contacts are made with teachers-in-training at the state colleges and with teachers-in-service at their schools, county meetings and summer normals. Through the office, we try to assist the teacher intelligently, furnishing her with the material she requests if possible, showing her better material if we have it, without condemning that which she is using.

There is still much to be done. We have a long way to go, but in reviewing the results of mouth hygiene programs over the past ten years, we realize that we have come a long way. In thinking of our present needs and the ideals we should like to reach, we know that we have a long way to go. This period, during which few can hope to increase funds for their work, offers itself as a time to evaluate our own activities, to learn the teachers' and children's needs and how to answer them and to give dentists a fundamental understanding as to what constitutes a dental health program and the great part they play in it. If we do these things, we shall surely shorten the road to our goal.

DENTAL SERVICE IN THE FLORIDA STATE HOSPITAL

By A. F. DOUGLAS,* D.D.S., Chattahoochee, Fla.

THE Florida State Hospital is the only institution in the state for the care of the indigent insane. It has at this time 3,893 male and female adult patients, representing all classifications of mental illness, and 660 employes. It is, of course, a state institution, maintained by taxation and legislative appropriation, and governed by the board of commissioners of state institutions made up of the governor and the six members of his cabinet.

A consideration of its present dental service must necessarily involve some history of its inception and its development over the period of the past eight years. Prior to 1926, a dentist had been employed, and emergency dental treatment had been given the patients, but the growth of the hospital had been so great that the service was inadequate, and, on April 15 of that year, I was empowered to reorganize it on as comprehensive a basis as resources would permit.

*Chief of dental staff.

EQUIPMENT AND PERSONNEL

At that time, the equipment consisted of a single chair outfit, none too modern or efficient, and practically no laboratory

or reception room facilities. Additional space was obtained out of which was developed three operating rooms, a small laboratory, sterilizing and "scrubbing up" corner, desk room, a modest reception room and record clerk accommodations.

In these quarters, the service functioned for nearly seven years, and although we rapidly outgrew them, they housed us during the development and broadening of the work to its present scope, and out of the experience of these years, with inadequate facilities, came the inspiration and the information necessary for the planning of our present complete infirmary, recently finished and occupied.

Fig. 1.—Dental Infirmary building.

The clinic now employs an entire one-story brick building 40 by 28 feet, which was formerly shared with the pharmacy, and consists of four complete operating rooms, a large laboratory, developing room, sterilizing room, personal office, record clerk's office, reception rooms for white and for colored patients and ample toilet and storage facilities.

Aside from $1,000 for an x-ray machine, there has never been a special appropriation for building or equipment for this service. From the general maintenance fund, out of which the institution as a whole is operated, this infirmary was rebuilt and equipped. The items of strictly dental machinery such as chairs, engines and cuspidors, have been gathered together over a considerable period as opportunity offered and have been refinished and "ducoed," and, while not ultra-modern, are efficient and complete in every respect. Operating room instrument and impression technic cabinets and soiled towel containers all made after patterns especially suitable to our needs, were manufactured by the cabinet makers in our construction department, as were storage closets and drawers, book cases, laboratory benches and cabinets, etc., and, of course, the general alteration, plumbing, heating and refinishing of the building was accomplished by the regular construction employes of the institution.

From one dentist in 1926, the personnel has been gradually added to until it now comprises a chief dentist, two assistant dentists, one laboratory technician, three dental assistants and a record clerk. The technician and the young women

assistants and record clerk, who were all taken from other departments of the institution, have been trained in their work over a period of years and are highly efficient in their particular fields.

THE SERVICE

At the outset, it was conceived that this service could be established and conducted on a basis comparable in methods and results to any dental clinic in any modern hospital. Moreover, it was realized that the unfortunate inmates were confined here through no fault of their own, with grave physical and mental illnesses, and powerless to dictate the treatment to be given them; which, of course, implied an obligation even more imperative than in a hospital where free agents were dealt with. The physical benefits to be derived from comprehensive dental treatment were obvious, and the hope was entertained that some contribution toward an improved mental condition could be made by this service. On this basis, then, the work was begun, and upon these ideals it has been developed to its present status, which embraces every phase of modern dental practice except orthodontia and extensive root-canal therapy.

Each new patient is examined within a week of his arrival and is never lost sight of until the indicated dental treatment is completed, contact being maintained by appointment slips that follow him to any department or hospital ward of the institution. This examination embraces two major items: "conditions found" and "treatment indicated." Under the former are noted "teeth missing," "restorations present," "soft tissues," "deposits," "masticating efficiency," "abnormalities" and "remarks"; under the latter, "extractions," "fillings," "crowns and bridgework," "removable appliances," "prophylaxis," "roentgenograms" and "remarks." These data, with "treatment given," which is recorded in minute detail, comprise the patient's dental record and are on file in the dental infirmary as well as incorporated in and

Fig. 2.—Personal office.

filed with his general case record, history, mental and physical diagnosis, medical attention, etc., and is available to those interested in him.

Fully 90 per cent of these patients are cooperative in the dental examination when first seen, appearing, in many instances, glad of the opportunity to have their mouths cared for and even requesting certain types of restorations and more or less immediate attention. As these new patients are not only mentally ailing, but, in most cases, also physically sick, their immediate treatment is instituted more largely from the broad aspect of their mental and physical rehabilitation than the prompt esthetic restoration of a missing or carious tooth. A large percentage of them present a condition of marked oral sepsis and unhealthy soft tissues, with many teeth missing, unsanitary fixed and removable bridges, faulty fillings, impacted teeth, etc., with only an occasional instance of a healthy and efficient mouth requiring no attention.

Therefore, the initial aim in each case is the immediate elimination of all pus conditions and those imminent, removal of unsanitary and inefficient prostheses, and thorough prophylaxis, to be followed by the restorative work indicated, as rapidly as the patient can have it done.

The plan of serial extractions, early found necessary in this work, is strictly adhered to, and thus unfavorable reactions are avoided in these already toxic cases. In consequence of this procedure and the strict surgical asepsis, we are rarely obliged to hospitalize a case, and we encounter surprisingly little post-extraction trouble.

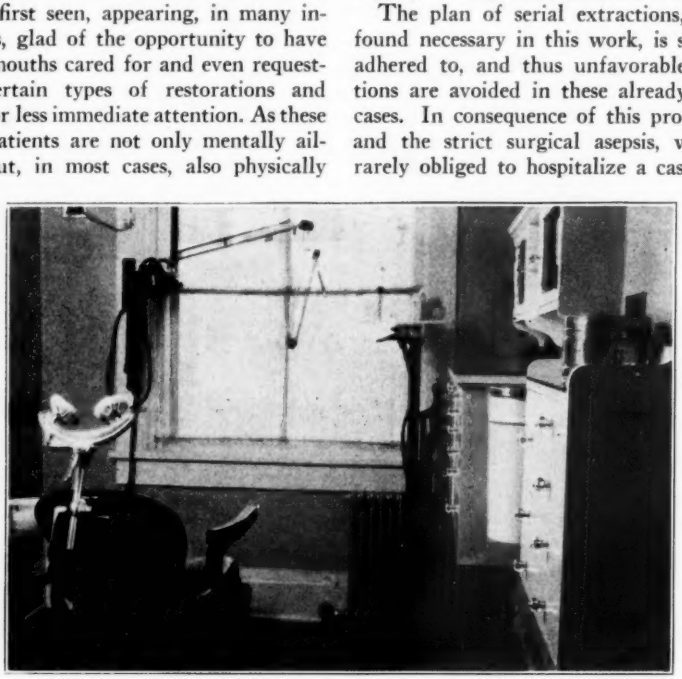

Fig. 3.—One of the operating rooms.

Fixed bridgework is used for the epileptics and extensively in other indicated situations, and removable pieces for patients able to care for this type of work.

Every sort of filling, cement, alloy, silicates; gold and porcelain inlays; cast gold and porcelain jacket crowns, etc., are made use of, being constructed with the same care and attention to esthetics as is common to modern practice.

We are, of course, equipped for com-

plete intra-oral and extra-oral roentgenographic examination, and thus cases are freely examined for diagnostic and checking information.

Prophylaxis occupies an important place in our routine, including besides the removal of deposits and polishing of teeth, the treatment of all forms of soft tissue irritation and disease ranging from gingivitis and all manifestations of peridontal lesions, to acute Vincent's infection and pronounced oral sepsis from a variety of causes. Brushes and dentifrices are furnished the patients and constant effort is made to educate and encourage them in the care of the mouth.

The denture service has been the source of great satisfaction. When this work was begun, there were many edentulous mouths and more being made edentulous constantly. It seemed questionable whether sufficient cooperation for the management of dentures could be obtained in mental cases to warrant the time and expense involved. No data were available in this connection, but the need for this work was so great that we felt justified in proceeding with it on an extensive scale even with an expectancy of comparatively meager success.

The results have more than justified the effort. Not only are these dentures efficient in from 60 to 70 per cent of the cases, but the cooperation given by the patients during the construction and in the wearing of the plates, and their pride of possession and gratitude for the service are greater than has ever been my experience in private work. Moreover, this service is without doubt an inestimable contribution toward the return to physical health in many of these cases.

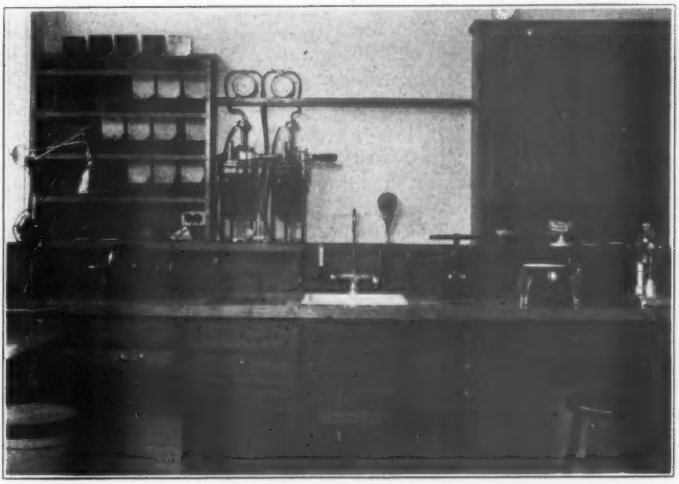

Fig. 4.—Laboratory.

The medical staff of the hospital consists of a chief physician and seven assistant physicians detailed to the various medical and surgical services. The association between the medical and dental staffs is very close, and the cooperation between them complete, in diagnosis and treatment, and in surgical work on the mouth and jaws.

It is my privilege to give a twelve

weeks' course of lectures on mouth hygiene and dentition each year to the senior class of student nurses of the training school operated in connection with the hospital. This course is enthusiastically received, and perhaps adds one more item to the prophylactic education of the lay people through these young women, as well as contributing something to their professional information and equipment.

Dental care for the 660 employes of the institution presents a problem solvable only by an increase in the personnel of the staff. These workers are for the most part on small salaries, and, in the light of this fact and from the point of view of their physical comfort and efficiency, are entitled to dental attention. In an effort to provide as largely as possible for them, we give them all the time that the patients are not available, and, of course, without charge. Furthermore, we care for any emergency that arises from any source at any time.

The foregoing will convey some idea of the scope of our work at this time. This service, like everything provided in the institution, is given the patients without cost; nor, let it be emphasized, is this department restricted as to the type of work furnished, or limited as to the quantity or quality of the materials used.

RESULTS

The following operations were completed over the period of the calendar year 1933.

Examinations	1,282
Extractions	4,653
Prophylactic treatments	1,790
Palliative treatments	545
Irrigations	1,279
Observations	2,962
Denture preparations and adjustments	2,001
Dentures delivered	658
Crown and bridge preparations and adjustments	706
Crowns and bridges delivered	231
Repair dentures	72
Repair bridges	31
Fillings	3,008
Roentgenograms	640
Hospital and ward visits	520
Fractures	9
Miscellaneous operations	18
Completed indicated dental treatment for	2,302
Total patients seen (sittings)	17,528
Total operations	20,264

That this work furnishes a substantial contribution to the comfort as well as to the general physical improvement and recovery of these patients there can be no doubt. A wealth of material is at hand in case histories to substantiate this fact, but systemic reaction to corrective dental work is too well recognized to require demonstration in this discussion.

Nor is it the intention to present evidence of mental cures or near cures as a result of this service. Our observations over the past eight years convince us that it plays a part direct and indirect in the improvement of and recovery from some of these mental conditions.

Psychiatrists have determined that the most common sites of focal sepsis contributing to toxic psychosis are the mouth and teeth, rectum and anus, cervix, pelvis and tonsils.

In these cases of toxic psychosis, it is plain that every condition which weakens the defense promotes an abnormal viewpoint; whereas, every condition which builds up resistance keeps the patient closer to mental reality. It would seem, then, that there exists a direct relationship between dental disease and that large group of psychoneuroses and psychoses of toxic character, and it is noticeable that almost coincidently with the elimination of areas of infection and impaction in the mouths of the patients committed with psychoses due to alcohol, drugs and other exogenous toxins, there occurs a clearing

up of the mental fog, and these patients rapidly take on weight and become cheerful and normal again.

In the psychoneurotic and psychopathic personality types, it can be said that the elimination of disease and pain from the mouth area contributes one of the stabilizing influences that these cases need so badly.

Even the senile cases show improvement in disposition, poise and outlook after the removal of diseased and nonfunctioning members, and take great pleasure in and express appreciation for artificial restorations.

Finally, there is apparently some evidence at hand of the not too remote influence of dental therapy in even the more complex mental diseases. In any event, it cannot be gainsaid that the relief of dental pain and distress, and the restoration of mouth efficiency by esthetic replacements, at least exerts a benign effect in all mental conditions, promoting dispositional changes for the better.

CONCLUSIONS

1. It is possible to organize the dental service in state mental institutions into modern, efficient clinics, and to extend to those committed to these hospitals the same care and the same variety of operations and restorations that are common to the best sort of private practice. Moreover, these patients are capable of cooperating in this treatment and most grateful for it.

2. The contribution of this work to restored physical health and improved mental equilibrium in these cases is a demonstrated fact.

3. The following facts and figures seem to prove that organized dentistry's responsibility in this matter is clear cut, if it is to maintain the high ideals of public service incumbent on all professions. There are 250,000 mental patients in the 165 state hospitals in the United States, 75,000 new patients being admitted annually to these institutions. Moreover, a greater number of hospital beds are de-

Fig. 5.—Sterilizing room and operating supplies storage.

voted to the care of the mentally afflicted in this country than to all other classes of patients combined; and for the dental treatment of this vast number of com-

Fig. 6.—Staff, assistants and technician.

mitted and helpless people, only ninety full-time dentists are employed.

4. The time is past when the mentally deranged are considered a dangerous burden to the state, to be merely confined for the safety and protection of the public. Modern science has determined them to be sick people, and modern institutions are using every known method for their recovery and restoration to health and usefulness, or the proper and humane care of those incurable. Men of high character and ability in the professions have been attracted to this work by its humanitarian aspect, and will be increasingly attracted as the standards are raised and opportunity is thus offered by large institutions for research and wide experience.

Nothing so interesting and absorbing as this work has entered into an experience of thirty years in dentistry, nor has there ever been encountered such complete cooperation and sincere appreciation and gratitude as is vouchsafed this service by these sick and unfortunate people.

My appreciation of our present staff and facilities is large, my faith in the future of the work is complete, and my gratitude is herewith expressed for the cooperation and freedom that have been extended me in the establishment and maintenance of this service.

HOW TO BUILD SOUND TEETH

CHILDREN'S TEETH PART I

CHILDREN'S TEETH PART II

Five thousand copies of this twenty-one page booklet compiled by the American Society of Periodontology are awaiting your use.

It consists largely of a series of questions and answers on the care of children's teeth. It covers the field of preventive dentistry in simple lay terms. It contains a fund of dental educational material for parents and teachers.

Because we are overstocked with this booklet, we are offering it to the profession for less than printing cost. Order a quantity for your waiting room and for distribution to your patients. Price 2½ cents per copy.

The Pyorrhea Tooth, Centennial Dental Congress, Hall of Science.

CENTURY OF PROGRESS EXPOSITION, Chicago, 1934

June 1 marks the reopening of Chicago's Century of Progress Exposition. For the past three months, hundreds of workmen have been busy transforming the exposition grounds. Old buildings have been torn down; new buildings are being erected; thousands of exhibits are being redesigned, reshaped and refurbished. Last year's visitors will find an entirely new exposition awaiting them. Organized dentistry will again be represented in the Hall of Science. The dental exhibits which proved to be the most attractive last year will be displayed again this year. Others will be rebuilt or replaced.

The "Pyorrhea Tooth," shown above, attracted so much attention last summer that it is being reconditioned for the 1934 Fair.

CURRENT LITERATURE

Facial Nerve Damage—Its Repair (H. B. Graham, Calif. & West. Med., March, 1934): Graham reviews the history from 1903 to the present of seventh nerve repair and gives a case report. Since such success has been obtained as reported in the references, he wonders why more cases have not appeared in the literature. He concludes that surgery of the facial nerve has passed the experimental stage.

Vitamin C Content of Canned Tomato Juice (Ray G. Daggs and A. G. Eaton, Indus. & Eng. Chem., March, 1934): This article comprises a report of assays made of canned tomato juice for vitamin C. The experimental procedure is given with a photomicrograph of the animal's teeth. The work indicates only a slightly lower content of vitamin C in the commercial tomato juice used as compared with the fresh tomatoes from which the juice was commercially extracted. The author tested only one brand and would not derogate any others as a result or raise all to the level of the one assayed.

Distribution of a Reducing Substance (Vitamin C) in the Tissues of Fluorine-Fed Cows (P. H. Phillips and F. J. Stau, J. Biol. Chem., February, 1934): In a previous report, it was suggested that chronic fluorine toxicosis is involved in some way with the function of vitamin C. This view rests on the hypothesis that fluorine toxicosis causes a disturbance of cellular metabolism interfering with normal oxidation and reduction processes. The data show that vitamin C has a wide distribution in the animal body. It is low in striated and heart muscle and high in the suprarenal cortex and the anterior lobe of the hypophysis. The vitamin C content appears to be increased by fluorine toxicosis in actively metabolizing cells. An increase of vitamin C content was observed in the kidney, liver, anterior lobe of the hypothysis and suprarenal cortex.

Vincent's Infection, with Report of a Case (W. T. Wilkins, J.A.M.A., Dec. 23, 1933): The patient had recurrent canker sores on the tongue and a chapped lower lip. The ulcer on the tongue disappeared, but the chap on the lip deepened. The submaxillary glands became tender. The lip was dry and parched, the mouth hot. The temperature rose to 102, the pulse to 95. There was no lymphadenopathy except in the neck. The patient was more toxic than the symptoms indicated. During four days after the patient went to bed, toxemia increased. A burning sensation in the epigastrium was accompanied by anorexia and food caused cramps. Canker sores reappeared on the tongue. Smears from lip and gum showed an occasional spirillum such as might be found in a normal mouth. Blood cultures for tularemia, undulant fever and typhoid were negative. The white cell count when the patient went to bed was 7,500. Two days later, it was 8,500; and a week later, 10,200. Twenty-four hours after 0.5 gm. of neo-arsphenamine was administered, the gums of both jaws became swollen and sore. Bleeding ensued. Smears were filled with spirilla and fusiform bacilli. The patient received three doses of neo-arsphenamine intravenously and four doses of bismuth compound intramuscularly during two weeks. Mouth washes of strong sodium perborate and diluted hydrogen peroxide were given. The gums were painted with arsphenamine and bismuth solution three times daily. General symptoms disappeared in four days. The lip was well in ten days. The glands lost their soreness in six days and were not palpable in ten. The gums looked normal in two weeks. Smears taken from the mouth eight

days after the first dose of neo-arsphenamine showed only an occasional spirillum and were negative in three weeks.

Granulocytopenia (Pauline Zinninger, J. A.M.A., Feb. 17, 1934): In the two cases here reported, the patients were sisters and reacted atypically. The author mentions that both patients had been edentulous for years because a surprising number of cases are reported as following the extraction of a tooth.

Foreign Literature

Two Rooted Mandibular Cuspid (Gerald Harborow, Brit. D. J., March 1, 1934): Harborow quotes Colyer and Bennett and contradicts the statement of the latter that the condition is invariably bilateral. He obtained nineteen specimens. The patients were mostly women. Three specimens were bilateral, sixteen unilateral. Of the unilateral, ten were from the left side and six from the right. The bifurcations were variable. In Hess' collection, 43 per cent showed bifurcation.

Some Experiments on Denture Retention—Some Physical Aspects of Retention (E. Matthews, Brit. D. J., March 1, 1934): The Dental Investigation Committee of the Dental Board has experimented with gratifying results with an antiexpansion technic for impressions and models, but limitation arose because of dimensional changes in the denture base itself. This makes the work on the plasters of no or little avail. Experiments are described and results given. Under aspects of retention, Matthews calls attention to the misuse and misunderstanding of terms. He dismisses "cohesion" as playing no part in retention. The forces of surface tension and atmospheric pressure interacting are primarily responsible for retention, excluding purely anatomic considerations.

Food Values and Their Practical Application in Dietetics (J. A. Nixon, Brit. M. J., abstr. J.A.M.A., March 3, 1934): Calcium and Phosphorus in Foods: Calcium is needed for bones, for the clotting of blood, for normal action of the heart, in the physiology of nerve conduction, and for the energy exchange of muscle contraction. It is found primarily in milk; fruits and vegetables are relatively rich, while meat and milled cereals are poor in calcium. Phosphorus is needed for the nuclear construction of every cell and is thus intimately concerned in all cell multiplication. It contributes largely to the bones and the plasma and other fluids, being found in organic union with proteins, fats and carbohydrates. It aids in the union with proteins, fats and carbohydrates. It aids in the work of various glands and can be found in their products, particularly in milk and the sexual elements. It is found abundantly in eggs and milk, also in wheat (entire grain, but not white flour), oatmeal, dried beans and many nuts. A growing animal can, however, fully supply its mineral requirements from inorganic sources; it is therefore unnecessary to consider the calcium, phosphorus and iron content in natural foods to the degree currently believed.

Lithiasis of the Submaxillary Gland and Wharton's Duct (Gerard Maurel, Rev. D. Canad., January, 1934): Submaxillary calculi are far from being rare, but the diagnosis is usually made late. Such calculi appear more frequently in men than in women. Age seems to have no particular significance. The number of calculi seen either in the gland or in the duct ranges from 108 or 10. The stones are not extremely hard. They are usually rich in phosphates. Two theories prevail as to their origin: that they are the result of salivary deposits and that they are of infectious origin. The author agrees with the second. The symptomatology of stones in the gland differs from that of stones in the ducts. Calculi of the duct are fairly evident to the diagnostician. They give rise to mechanical or infectious accidents. The differential diagnosis is given in detail. The treatment of submaxillary calculi of necessity is surgical. Local anesthesia may be used, but frequent infection makes general anesthesia preferable.

Permeability of Cementum (H. H. Stones, Brit. D. J., March 15, 1934): The purpose of the investigation is to determine whether cementum is permeable to lymph.

If it is, it is subject to infectious processes of the contiguous tissues. Staining procedures from within and without are given, the teeth of dogs and rats being used. The findings are: Primary cementum of young dogs is permeable from both the peridental membrane and the pulp canal. Early in life, a calcific barrier cuts off the cementum from the dentin. Later still, the lymph permeation from the peridental membrane is cut off. Eventually, in adults, cementum is entirely impermeable. Secondary cementum contains enclosed cementoblasts the lacunae of which are intercommunicable and likewise connect with the dentinal tubuli. This permeability decreases with age until, in young adult dogs, only the apical regions show communication. Secondary dentin is permeable from the peridental membrane until adult life. In old dogs, only the outer layers are permeable.

Teeth and Rheumatism (Mathieu-Pierre Weil, L'Odontologie, January 30, 1934): The author discusses the present-day concepts of the relation between rheumatism and dental disease. The importance of this relationship has only become significant within the past twenty years. From statistical studies from various countries, he states that rheumatism rather than tuberculosis or syphilis is of greater social consequence. The theories on focal infection are reviewed and the belief that streptococci are nearly always the causative agent of the infection is considered and refuted. The author points out that experiments have shown that it has never been possible to isolate the streptococci in the circulating blood or in the joints from synovial or serous effusions. Of two kinds of rheumatism mentioned, the first involves changes in the bone and cartilage, and this the author calls ostearthritis. The second involves the synovial membrane of the joint and this he calls rheumatoid arthritis. Necrosis and degeneration cause the first type. It is not an infectious disease, but rather one caused by bad posture, overwork and articular fatigue. It is useless to remove teeth in treatment of this form of rheumatism. There is another clinical form wherein the synovial membrane is attacked in the initial stages of the disease. It is fairly evident that bacterial infections are the cause of this disturbance. Still a third group of clinical manifestations may be described. Pains appear in several joints and there are no purulent changes in the joints, simply inflammation. With this form, there are never bone lesions. The author undertakes to explain these manifestations of focal origin on the basis of an anaphylactic reaction (hyperergasia). A sensitizing agent, bacterial or protein, passes over the joint by way of the blood stream leaving it in a more susceptible state for its next passage. In the presence of infectious rheumatism, it is essential to regard the teeth with suspicion and to remove any probable offender. A dentist cannot promise complete remission of the rheumatic disturbance after caring for the teeth, but it is frequently the case that relief is experienced by the patient after such treatment.

Biologic Treatment of Roots with Amputation of the Pulp of Devitalized Teeth and Also with Root Canals (Dr. Wohlgemuth, L'Odontologie, January, 1934): All dentists know that the actual and lasting results of treatment of roots are very questionable. This is especially true when the root is gangrenous. The fundamental cause of this failure is the anatomic peculiarities of the canals. The place of least resistance in all the root treatments is situated in the apical foramen, where there is nearly always retention of infected matter. In the pulp chamber, there are frequently transverse canals between the pulp and the periodontium. With the present methods and antisepsis, actual sterilization and complete filling of the canal are seldom obtained. Another cause of failure is the type of disinfectants available. These frequently provoke lesions of the periapical tissue. Tissues in which there is a greater blood supply support more concentrated quantities of antiseptics than the tissue wherein the blood circulation and the vascular systems are less perfected. In any case, all tissues react badly to strong antiseptic solutions. The tissue found in the

region of the apical foramen is made up of cellular connective tissue which has a generous blood supply. All disinfectants which are commonly used are harmful to these tissues. They hamper and burden the biologic processes of defense in the tissue. On the basis of the foregoing, the author says that a new method of root canal treatment should be found, one which avoids damaging the periosteum by either mechanical or chemical methods. An alkaline state should be maintained in the root canal. A mild but effective antiseptic should be found. Experiments to this end are under way and further report will be made on them.

Chemical and Physical Properties of Bone in Experimental Scurvy (G. Bayer, Beitr. z. path. Anat. u. z. allg. Path., abstr. Am. J. Dis. Child., March, 1934): Chemical analysis of scorbutic bones showed an undisturbed percentage composition and total mineral content as compared with normal bones. Nevertheless, the diaphyses of the long bones showed increased fragility. The latter was probably due to osteoporosis.

Antiscorbutic Value of Juice of Bananas Ripened in Sweden (K. Wejdling, Acta paediat.; abstr. Am. J. Dis. Child., March, 1934): Bananas brought to Sweden while still green were allowed to ripen until the skins were yellow with a few black spots. They were peeled quickly to prevent undue oxidation and mashed *in vacuo*, and the juice was pressed out in an atmosphere of carbon dioxide and stored in the icebox for a maximum period of four days. No antiscorbutic value (protection tests on guinea-pigs) could be demonstrated when this juice was used in amounts of from 4 to 20 c.c. daily, corresponding to from 5 to 25 gm. of whole banana.

Congenital Epulis (D. Stewart Middleton and W. F. Harvey, Edinburgh M. J.; abstr. Am. J. Dis. Child., March, 1934): Congenital tumors of the gum are rare. This case brings the number in the literature to fourteen. At 5 weeks of age, the patient was seen because of a tumor of the gum and difficulty in nursing. The tumor is described as a small pinkish growth, ovoid laterally and the size of a cherry. It was visible between the lips, the upper lip being everted by it. The growth was firm in consistency. The covering was normal mucous membrane attached by a pedicle to the gum margin of the upper jaw just to one side of the midline, in the location of the future left central incisor. The cases reported show that a tumor of this type always occurs in the incisor region of the gum and always in a female child. It does not interfere with the eruption of the tooth. The authors' report includes the results of the pathologic examination, which showed a polypoid growth. The microscopic sections shown are clear and excellent; the tumor cells display no organoid pattern and seem to be of mesodermic origin. The growth is regarded is a maldevelopment of the musculature with degenerative but not xanthomatous changes. It was probably not a true neoplasm.

To Purify or Freshen Gold for Casting (Australian J. Dent., Feb. 1, 1934, abstr. Brit. J. D. Sc. and Prosthetics): Melt the used or scrap gold on a charcoal block, and when the gold is molten, sprinkle it with a powder made by mixing one part of borax with three parts of potassium nitrate. Keep the gold molten for a few minutes after putting the powder on and it will be as good for casting as new gold. Never use any gold a second time for casting without purifying it in the manner described above.

Physiology and Pathology of Erupting Teeth (M. Wasmund, Zahnarztl. Rundschau., 43:238-249, 286-294, 1934): The dental follicle plays an important rôle in the disturbance of tooth eruption as far as the penetration and spreading of infection is concerned. Even teeth that have no difficulty in erupting leave far-reaching and highly graded disturbances in the bone, periodontal membrane, cementum, pulp and nearby nerve trunks. In third molars with crowns erupted through the bone, but covered with soft tissue, epithelial cysts often occur owing to the spreading of inflammation from the tooth follicle. The suturing of flaps after the removal of a not totally erupted third molar may cause a cyst formation. Follicular cysts of retained

teeth often originate from an inflammatory irritation brought about by an inflamed tooth follicle. The infectious inflammation in the dentition of deciduous teeth may possibly be the cause of pain in dentition and tooth fever.

Capillary Examination During Pregnancy (F. Burchardt, Paradentium, 6:17-22, 1934): The author examined with the aid of a capillary microscope the nail grooves, lips and gums of pregnant women. In most cases, disturbances in the capillary system occur. Universally, absolutely typical changes in cases with gingivitis could not be established. In some cases with normal gum tissue, capillary disturbances are observed; while, in others, there are no disturbances at all. The author describes and discusses five specific cases. In a great number of cases, there exists a vasolabile condition in the early months of pregnancy, which increases in the late months, in some cases resulting in catarrhal changes. Constitutional conditions are a predisposition of paradentosis during pregnancy.

Changes in the Dental System in Severe Diseases of Infancy (E. Seeberger, Vierteljahrsschr. f. Zahnheilk., 49:146, 1933): A study of twenty-seven children showed that grave severe nutritional disturbances and infectious diseases produce permanent changes in the dental and skeletal system. Rickets was found to be less important as an etiologic factor than is generally believed. The dental disturbances were enamel hypoplasia, dentition anomalies and jaw deformities of varying degrees. The localization of the enamel hypoplasia coincided in almost all cases with the time of the disease. It was not possible to establish a correlation between the systemic disturbances and susceptibility to caries. The first permanent molars were destroyed in all cases. The change in dentition was frequently retarded. This phenomenon was found to be in most cases a symptom of general stoppage of growth which affected body-length, body-weight and the long bones. Of special interest was the fact that, in many cases of jaw deformities, it was possible to eliminate rickets as an etiologic factor. These jaw disturbances were produced by a severe skeletal calcium deficiency, in each case associated with a severe general metabolic disturbance. In the second year of life, there is a certain predisposition to porotic changes because of the physiologic osteoporotic condition at this time.

Age Changes in Dentin (M. Brodersen, Morph. Jahrb., 60:465, 1930): The dentin lamellae of v. Ebner which are growth stripes and the layer of longitudinal fibers in the outer dentin were studied in decalcified human and cattle teeth. The fibrillar layers of the growth stripes change with increasing age from the known oblique to a purely longitudinal course. We can thus estimate the age of a tooth by the typical change in the completed dentin. This change in direction of the fibrillae is associated with a change in the distribution of calcium in the aging tooth. A local adaptation of the fibrillar layers to fillings or abrasion was not observed.

More Than 5.000 Ahead

Talk about the depression—No, let's not talk about it. It's vanishing—at least as far as membership in the A.D.A. is concerned.

At the time of going to press our membership is more than 5,000 ahead of the figures of this time last year.

A five thousand gain before the first half of the year is a notable achievement, and we are really just getting started.

Wait till our Membership Committee actually reaches its stride; wait till our members generally begin to visualize just what personal appeal from each of us can do with a halting fellow practitioner to bring him in; wait till we are all fully in action like the men already at work, and we will crowd that magical 50,000 pretty nearly over the top.

Remember Our Slogan . . . 50,000 Members!

NEWS

CALIFORNIA

Nation-Wide Survey: The nation-wide survey being conducted by the American Dental Association to determine the dental needs of school children, from the kindergarten through the grades, is under way in California under the direction of C. T. Messner, chief dental surgeon of the U. S. Public Health Service, who is chairman of the examination committee.

State Board Officers: Wilfred H. Robinson has been re-elected president of the California State Board, and Dr. Nesbitt is once more the secretary.

Dental Survey of the Institutions of California: The dental problem in California consists in: (1) the inadequate dental quarters in the larger institutions; (2) the smaller institutions with no dental equipment; (3) the more than 47,000 infected teeth in need of extraction; (4) the more than 33,000 teeth presenting cavities; (5) the fact that half of the patients are suffering with mouth infections, caused mostly from neglect of oral hygiene; (6) the fact that there is no educational activity to instruct the employes or patients in the care of the mouth; (7) the fact that few patients in the mental hospitals are equipped with a toothbrush; (8) the haphazard method of keeping dental records, with no attempt at standardization. Attack on the problem required six months from Jan. 1 to July 1, 1933. 1. Twelve dental chairs and units were obtained from the department of universities, which doubles the present equipment. 2. Larger and better dental clinics were established in the more populous institutions. The two institutions having no dental equipment were well equipped. 3. A simple method of toothbrush instructions was inaugurated and today each patient in the thirteen institutions has his or her teeth brushed from once to three times a day. 4. Thirty-two thousand toothbrushes were used during the last fiscal year, and nearly 2 tons of tooth powder. 5. Record system changes were made so that active record could be maintained as to the activity of the Dental Department. The remarkable feature of the dental survey is that the amount of dental service was increased nearly 100 per cent over that of the preceding year.

DISTRICT OF COLUMBIA

Legislation: Resolutions relating to contract dentistry were by unanimous vote sanctioned and recommended to be drafted into the Constitution. Two bills pertaining to dentistry were presented at a recent session. House Bill 196, relative to a personal service and professional service tax, is now a law, and the medical and dental professions have joined with others affected on testing its constitutionality before the state supreme court. The other bill, House Bill 260, relative to advertising, had no support, and did not get out of committee.

ILLINOIS

Death of Harry J. Bosworth: Mr. Harry J. Bosworth, of Chicago, widely known as a dealer in dental supplies, passed away April 18. He was born in Cannon Falls, Minn., September 1, 1874. The widow, Anna Rogers Bosworth; his mother, and his brother, Robert R. Bosworth, D.D.S., of Chicago, survive.

INDIANA

Results of State-Wide Examinations: Indiana is one of four states in which the dental survey has reached state-wide proportions. The following are the results of the state-wide dental examination of first to eighth grade school children: total number pupils examined, 7,528; total number needing dental treatment, 6,426; total number needing no treatment, 1,086; total number needing orthodontic care, 775; total extractions needed, 7,887; total number fillings needed, 46,214. Of all examined, 85 per cent needed dental attention, and 12 per cent needed orthodontic treatment.

KANSAS

Council on Health Promotion: At a meeting of the Butler-Greenwood County Medical Society in Eureka, January 12, a "professional council on the promotion of

public health" was inaugurated in an attempt to combine medicine, dentistry and pharmacy for the consideration of problems common to the allied professions. C. A. Northcutt, D.D.S., Ponca City, Okla., addressed the meeting on "The Interrelationship of Dentistry and Medicine."

MISSISSIPPI

Dental Practice Act: H. 603, the dental practice act, proposes to make it unlawful for dentists to use handbills, posters, circulars and other advertising devices and means other than such professional cards or announcements as are specified in the bill.

NEW YORK

Bills Introduced: S. 1084, to amend the medical practice act, proposes to define the practice of medicine to include the administration of anesthetics. It is not to apply to licensed dentists who administer anesthetics in connection with the practice of dentistry. A. 1377 proposes to prohibit a corporation from using the word "Doctor" or "Dr." as a part of its corporate name. A. 1513 proposes to require every person who compounds or manufactures any drug, medicine, chemical, dental, pharmaceutic or cosmetic preparation to register with the state department of health, as a condition precedent to his right to sell his product, the exact proportions of all ingredients used in it. The department is authorized to refuse to grant registration to any applicant whose compound or preparation it deems deleterious or injurious to public health.

MICHIGAN

The Committee on Postgraduate Instruction in the Medical Sciences of the University of Michigan reports that, January 25, clinical demonstrations covering ten subjects were presented at the University Hospital and at the dental school to approximately 375 dentists. The plan now is to divide the state into sections and to offer to each section in turn intensive one-day postgraduate courses on two or three subjects at a time. The committee expects later to present some instruction on certain subjects, which will cover a period of two or three days, or perhaps a week. It is the plan and purpose of the committee to keep the expenses to the individual dentist at a minimum for these courses, but probably for courses which cover more than one day, a small fee will be charged to meet the expenses of this instruction.

State Dental Board to Organize After Court Victory: The Michigan State Board of Dentistry will proceed to organize at once, under the provisions of Act 235 of the Public Acts of 1933, after a decision handed down by the Judge of the Wayne County Circuit Court, January 31. The state board has heretofore been restrained by court order from organizing under the new act, and from adopting such rules and regulations as it deemed necessary and expedient to carry out the mandate of the state legislature as expressed by the terms of the act itself. The action was instituted by a group of dentists who claimed that their rights under the state and federal constitution would be violated, should the act be upheld; that the act itself was not properly passed; that the act provided for an unlawful delegation of legislative and judicial powers; that it gave the state board power to revoke licenses for violation of its rules and regulations; that the act did not set forth any standard of conduct by means of which the state board might lawfully act; and further that the making and enforcement of rules and regulations would work irreparable injury to themselves. They asked the Court to declare the act unconstitutional, null and void; that Act 7 of the Public Acts of 1921, which act governed the practice of dentistry before the act of 1933 was enacted, remain in full force and effect, and that a permanent injunction be issued enjoining the defendants from doing any act or thing to carry out or enforce any of the terms and provisions of Act 235 of the Public Acts of 1933, Regular Session. The state dental board filed an answer to the plaintiff's bill of complaint on behalf of the State of Michigan. The Michigan State Dental Society and the Detroit District Dental Society intervened as party defendants and filed their individual answer to plaintiff's bill of complaint. The matter then came on for hearing and

after several legal tilts was submitted to the court on briefs. The court, in its decision, dissolved the restraining order and dismissed the plaintiff's bill of complaint, thus leaving the state board free and unhampered to carry into immediate effect the provisions and terms of the new law. It is probable that an appeal will be taken by the plaintiffs to the state supreme court in Lansing. Such action, if taken, should inure to the benefit of the dentists of the state at large, because it would render a final adjudication of the 1933 Act, and the decision, if affirmed, would enable the state board to wage a more effective campaign against those who would prostitute the dental profession.

North End Clinic Report: Figures that have just been released by the North End Clinic reveal the service that has been rendered for the past ten months by a group of Detroit dentists under the sponsorship of the Alpha Omega Fraternity. During this period, the staff of thirty-five dentists has extended temporary relief and diagnostic service to approximately 5,000 patients. Of this number 3,984, or 80 per cent, were given free treatment, while the remaining 20 per cent paid a small fee. These dental services were only given to patients who had been investigated by social service workers and declared unable to obtain regular private treatment.

MISSOURI

Relief Fund: The local committee on the A.D.A. Relief Fund, operating under the direction of E. H. Keys, presents the following: The state contribution last year was $1,094.30, of which St. Louis contributed $413.00, or 37 per cent. This year it fell to $918.50, of which St. Louis contributed $675.50, or 73 per cent. Although membership declined, the numbers of members contributing increased in every one of the six districts (in the fifth district, more than 250 per cent). The average contribution per member in all districts increased, the highest contribution average being in district No. 3, with an average of $1 per member for the entire city.

NEBRASKA

Nutrition Included in Curriculum: Nutrition in its relation to dental pathology is now included in the Creighton University College of Dentistry curriculum. Acting Dean F. J. Viner announced that with the beginning of this semester it would be provided for the juniors under the direction of Victor Levine, M.D., professor of biochemistry and nutrition, School of Medicine.

NEW YORK

Debate: The Greater New York December Meeting Committee held a debate at the Hotel Pennsylvania, March 27, the subject being: "Resolved: That a clean tooth does not decay and that mouth cleanliness affords the best known protection against dental caries." The affirmative was presented by Thaddeus P. Hyatt, Alfred Walker and Maurice William; the negative side by E. V. McCollum, Weston A. Price and Arthur H. Merritt.

Illegal Practitioners Convicted: In one month, the State Board of Dental Examiners has succeeded in obtaining five convictions against illegal dental practitioners in Kings County.

RHODE ISLAND

State Society Officers: Following are the officers of the Rhode Island State Dental Society for the year 1934: president, Harry F. McKanna, West Warwick; vice president, Morris R. Lebow, Providence; treasurer, Francis A. Holland, Providence; secretary, Charles J. Smith, Providence; editor, Edward C. Morin, Pawtucket; librarian-curator, Mark Tishler, Newport.

GENERAL

Dental Education: Eight schools of dentistry in the East and Middle West have recently formed the association for the advancement of university education in dentistry. The newly formed body announces as its aims the fostering of rational integration of dental with medical education, development of the science of dentistry and mutual improvement of the subscribing schools. It advocates two years of predental education and four of professional

training and its membership is restricted to schools now operating under that plan or those that have publicly announced the adoption of the two-four year plan and the approximate date when it will be put in operation. Members of the association are: University of Buffalo School of Dentistry; Columbia University School of Dental and Oral Surgery; Harvard University Dental School; University of Illinois College of Dentistry; Ohio State University College of Dentistry; Thomas W. Evans Museum and Dental Institute School of Dentistry, University of Pennsylvania; Tufts College Dental School and Western Reserve University School of Dentistry.—*J.A.M.A.*, March 31, 1934.

FOREIGN

Ceylon Dental Association: The Ceylon Dental Association, which is an affiliated body to the British Dental Association, closed its first year of existence on January 17. Prompt recognition by the government of the island has stimulated the association to much activity and it is able to record to its credit some amendments and deletions of dental regulations governing the practice of dentistry in Ceylon. For instance, in future, only such qualifications as are recognized by the Dental Board of the United Kingdom will be registrable there. The title "dental surgeon" is also confined to the academically qualified. The association is also figuring prominently in the scheme for a proposed dental school.

Entrance Requirements, Emphasizing Standards of Acceptance from Both Foreign Universities and Foreign Dental Schools: Dental education in Switzerland is conducted in Zurich, Geneva, and also in Basel and Berne. In these, the dental institute is a department of the corresponding university (Universität von Zurich, Université de Geneve). For the diploma entitling the holder to practice in any of the cantons of Switzerland, which is awarded by the state, and confers the title "Zahnartz" or "Dentiste" according as it is in German or French Switzerland, four years are required. A gymnasium or high school certificate is required for entrance to the dental school. This is called "Le Certificat de Maturité" in French Switzerland, and "Maturitats-Zeugnis" in the German speaking part. Typical certificates cover the following subjects: French language and literature, German, Latin, English, philosophy, history, geography, mathematics, physics, chemistry, and natural science.

Syria: The American University in Beirut, Syria, has a course similar to the American as it is conducted under American auspices. Four years of dentistry are preceded by one predental year of college grade in the university, in which it compares well with our own dental schools.

Egypt: A new dental school organized in Cairo in connection with the Egyptian University is conducted along the lines of British dental schools. A university matriculation examination or its equivalent is required for entrance.

India: There are two private dental schools, the Calcutta Dental College and Hospital at Calcutta, and another at Karachi. Both have a three-year course, and a university matriculation standard is stated in their catalog to be required for entrance. Another school exists at Bombay in connection with Grant Medical College, of which little is known. There are no dental laws as yet in India, but the matter is widely agitated. A government dental school in Bombay and another in Punjab have already been approved, but are not yet in being.

Japan: Dentistry is highly developed in Japan. There are three dental schools, all independent, which are *"designated"* by the minister of education. This means that graduates of these schools, on receiving their degrees, are automatically entitled to practice. These schools are the Tokyo Dental College, the Nippon Dental College and the Osaka Dental College. The first two have a four-year course and last a three and one-half year course. Graduates of these three schools are permitted to use the degree *Shikwa-Igakushi* (doctor of dental science). Graduation from a Japanese middle school is required for admission. The standard of this is equivalent to our four-year high school. There are two other dental schools which have college

rank, the Tokyo Dental College, and Kyushu Dental College, with three-year courses. There are five other schools not of college rank.

Latin America: In the Latin American republics of Central and South America, the completion of the secondary school course of from three to six years usually carries with it a degree which, translated into English, is "bachelor." This is preceded by a primary school curriculum covering from five to seven years. The secondary school certificate or diploma admits to the dental schools generally, though in Uruguay, Peru, Mexico and Chile, additional courses either in special preparatory schools or institutes connected with the university are required. The title bachelor varies as to the course upon which it is based and must not only always be regarded as a secondary school diploma, but also must be evaluated in accordance with the requirements of the country in which it is issued.

Deaths

Barker, J. Tenney, New Haven, Conn.; Philadelphia Dental College, 1884; died, March 24; aged 69. Dr. Barker was a former vice-president of the National Board of Dental Examiners. The widow and a son, John Eric Barker, D.D.S., survive.

Bowles, George C., Detroit, Mich.; University of Pennsylvania, 1899; died, February 18; aged 63. Dr. Bowles was the librarian of the University of Detroit Dental College.

Braun, Irwin C., Berwyn, Ill.; University of Illinois, College of Dentistry, 1927; died, March 21. The parents and a brother, Leslie J. Braun, D.D.S., survive.

Heper, Carl, Chicago, Ill.; Chicago College of Dental Surgery, 1898; died, March 21; aged 56. Dr. Heper was also a graduate of the Northwestern University School of Pharmacy.

Pfeifer, Josephine M., Chicago, Ill.; American College of Dental Surgery, 1892; died March 5. Dr. Pfeifer was one of the first woman dentists in the middle west. She was a founder and the first president of the Women's Dental Club.

Rettich, Hugo, New York City; Temple University School of Dentistry; died, February 20.

Saum, Ira M., Cleveland, Ohio; School of Dentistry of Western Reserve University, 1902; died, February 19; aged 58.

BOOK REVIEW

Chemical Foundation of the Processes of Life. By Carl Oppenheimer; 298 pages, Leipzig, 1933, George Thieme, publisher. The author divides the book into the following parts: 1. The living substance as a chemical system. 2. The structure of the living substance. 3. Formation and destruction of the nutritional and cell material. 4. The chemical mechanism of the cell processes: katalysis, fermentation, desmolysis. 5. The energy of the living substance. He discusses the foundation of life from a chemical point of view. He gives full recognition to the botanist, microbiologist, zoologist and physician. He claims that biochemistry is the main science and ought to be placed in the foreground. It is of great importance to the dentist to understand the metabolic changes that occur in the living body in health and in disease and their relation to dentition. Life is ordained both in healthy and sick days by mysterious powers that influence the organization of structures and organs. Chemicophysical processes are the center and they are the ruling influence in the healing of all disease.

ANNOUNCEMENTS

(Announcements must be received by the fifth day of the month in order to be published in the forthcoming issue of The Journal.)

CALENDAR OF MEETINGS

American Dental Association, St. Paul, Minn., August 6-10.

American Academy of Periodontology,

St. Paul, Minn., August 2-4.

American Association for Advancement of Oral Diagnosis, St. Paul, Minn., August 6.

American Dental Society of Europe, The Hague, Holland, May 18-21.

American Full Denture Society, St. Paul, Minn., August 4-5.

American Public Health Association, Pasadena, Calif., September 3.

American Society of Oral Surgeons and Exodontists, St. Paul, Minn., August 3-4.

Association of American Women Dentists, St. Paul, Minn., August 6.

Canadian and Ontario Dental Associations, Toronto, May 21-23.

Congress of Radiology, Zurich, Switzerland, July 24-31.

Great Lakes Association of Orthodontists, Toronto, Canada, May 7-8.

International Congress of Radiology, Zurich, Switzerland, July 24-31.

Mid-Southern Postgraduate Dental Clinic, Memphis, Tenn., October 22-24.

Montreal Dental Club Clinic, October 18-20.

Society for Advancement of General Anesthesia in Dentistry, New York City, third Monday in February, April, October and December.

Southern Society of Orthodontists, Hot Springs, Va., July 16-17.

District of Columbia, at George Washington University, Washington, D. C., second and fourth Tuesdays in each month from October to June, inclusive.

American Dental Hygienists Association, St. Paul, Minn., August 6-10.

STATE SOCIETIES

May

Arkansas, at Little Rock (14-16)
Illinois, at Springfield (8-10)
Indiana, at Indianapolis (21-23)
Iowa, at Cedar Rapids (1-3)
Kansas, Missouri and Oklahoma (Tri-State) (6-9)
Maryland, at Baltimore (7-9)
Massachusetts, at Boston (7-9)
Nebraska, at Lincoln (21-24)
New York, at Buffalo (9-12)
Pennsylvania, at Pittsburgh (1-3)
South Dakota, at Mitchell (7-8)
Vermont, at Burlington (16-18)
West Virginia, at Clarksburg (21-23)

June

Southern California, at Los Angeles (4-6)
Colorado, at Denver (18-20)
Georgia, at Atlanta (11-13)
Maine, at Augusta (22-23)
New Hampshire, at Lake Sunapee (27-28)
North Carolina, at Wilmington (18-20)
Oregon, at Portland (20-23)
Washington, at Tacoma (14-16)
Wyoming, at Cheyenne (22-23)

STATE BOARD OF DENTAL EXAMINERS

Alabama, at Birmingham, June 25. E. W. Patton, Secretary, 1807 Comer Bldg., Birmingham.

Arkansas, at Little Rock, June 18-21. Clarence W. Koch, Secretary, 817 Doneghey Bldg., Little Rock.

California, at San Francisco, May 21, and Los Angeles, June 18. Kenneth I. Nesbitt, Secretary, 450 McAllister St., San Francisco.

Connecticut, at Hartford, June 27-30. Almond J. Cutting, Recorder, Southington.

Delaware, at Wilmington, June 20-21. W. S. P. Combs, Secretary, Middletown.

Georgia, at Atlanta, May 31. R. C. Coleman, Joint Secretary, State Examining Boards, Department of State, Atlanta.

Indiana, at Indianapolis, June 12-17. J. M. Hale, Secretary, Mt. Vernon.

Kentucky, at Louisville, June 5-8. Robert L. Sprau, Secretary, 970 Baxter Ave., Louisville.

Maine, at Augusta, June 25-27. Alton H. Swett, Secretary, 192 State St., Portland.

Massachusetts, at Boston, June 12-15. W. Henry Grant, Secretary, Room 141, State House, Boston.

Minnesota, at Minneapolis, June 22-28. Hilen D. Aldrich, Secretary, 1104 Lowry Medical Arts Bldg., St. Paul.

Mississippi, at Jackson, June 19-21. T. Ford Leggett, Secretary, Laurel.

Missouri, at St. Louis, June 6-9. George E. Haigh, Secretary, Central Trust Bldg., Jefferson City.

Montana, at Helena, July 9-12. Leonard A. Jenkin, Secretary, Medical Arts Bldg., Great Falls.

New Jersey, at Trenton, June 25-30. John C. Forsyth, Secretary, 148 W. State St., Trenton.

Nebraska, at Lincoln and Omaha, June 11-16. Mrs. Clark Perkins, Director, Bureau of Examining Boards, Lincoln.

New Mexico, at Albuquerque, June 27-29. J. J. Clarke, Secretary, Artesia.

Ohio, at Columbus, June 25. Morton H. Jones, Secretary, 1553½ N. Fourth St., Columbus.

Pennsylvania, at Philadelphia and Pittsburgh, June 19-23. W. A. McCready, Secretary, 1115 Highland Bldg., Pittsburgh.

Rhode Island, at Providence, June 26-28. Albert L. Midgley, Secretary, Union Trust Bldg., Providence.

South Carolina, at Spartanburg, June 7-9. David Aiken, Secretary, Winnsboro Bank Bldg., Winnsboro.

South Dakota, at Sioux Falls, June 28-30. John J. Berry, Secretary, Deadwood.

Tennessee, at Memphis, June 11-16. B. C. Gallimore, Secretary, McKenzie.

Texas, at Houston, June 25-29. J. T. Edwards, Secretary, 1315 Medical Arts Bldg., Fort Worth.

Utah, at Salt Lake City, June 27-30. H. D. Brockbank, Secretary, 1003 Medical Arts Bldg., Salt Lake City.

Vermont, at Montpelier, June 25-27. H. B. Small, Secretary, Burlington.

Virginia, at Richmond, June 12. John M. Hughes, Secretary, Medical Arts Bldg., Richmond.

Wisconsin, at Milwaukee, June 18-22. S. F. Donovan, Secretary, Tomah.

COLORADO STATE DENTAL ASSOCIATION

(Place of Meeting Changed)

The annual meeting of the Colorado State Dental Association will be held in Denver at the Cosmopolitan Hotel, June 18-20, instead of in Colorado Springs as previously announced.

Joseph G. Ewers, *President*,
925 Republic Bldg.,
Denver.

NORTH CAROLINA DENTAL SOCIETY

(Place of Meeting Changed)

The place of meeting for the annual convention of the North Carolina Dental Society has been changed to Wilmington, the Cape Fear Hotel. The date is June 18-20.

D. L. Pridgen, *Secretary*,
Fayetteville.

BOARD OF DENTAL EXAMINERS OF ALABAMA

The Board of Dental Examiners of Alabama will conduct its next annual dental and dental hygiene examinations in Birmingham, commencing at 8:30 a.m., June 25. Failure to submit all credentials to the secretary's office at least two weeks before the date of the commencement of examination will have the effect of barring the applicant from examination. For further information address

E. W. Patton, *Secretary*,
1807 Comer Bldg.,
Birmingham.

GEORGIA STATE BOARD OF DENTAL EXAMINERS

The Georgia State Board of Dental Examiners will meet May 31, at 9 a.m., at the State Capitol, Atlanta.

R. C. Coleman, *Joint Secretary*,
State Examining Boards,
Department of State,
Atlanta.

MASSACHUSETTS BOARD OF DENTAL EXAMINERS

The Massachusetts Board of Dental Examiners will hold an examination for registration of dentists and hygienists in the City of Boston, June 12-15. Full information, application blanks, etc., can be obtained by applying to W. Henry Grant, Secretary, Room 141, State House, Boston. All applications must be filed at the office of the secretary at least ten days before date set for examination.

MINNESOTA STATE BOARD OF DENTAL EXAMINERS

The next regular meeting for examination of the Minnesota State Board of Dental Examiners will be held at the College of Dentistry, University of Minnesota,

June 22-28. For application and further information, address

HILEN D. ALDRICH, *Secretary,*
1104 Lowry Medical Arts Bldg.,
St. Paul.

MISSOURI DENTAL BOARD

The next examination of the Missouri Dental Board will be held at the Washington University, St. Louis, June 6-9. All applications must be in the hands of the secretary at least ten days before the date of examination. For information, address

GEORGE E. HAIGH, *Secretary,*
Central Trust Bldg.,
Jefferson City

NEBRASKA DENTAL BOARD EXAMINATION

The next examination for license to practice dentistry in Nebraska will be held, June 11-16. The examination in practical work will be held for the first three days at the University College of Dentistry, Lincoln, and at Creighton College of Dentistry, Omaha. The examination in written work will be given the last three days in Lincoln, at the State House.

MRS. CLARK PERKINS, *Director,*
Bureau of Examining Boards,
Lincoln.

NEW MEXICO BOARD OF DENTAL EXAMINERS

The next regular meeting of the New Mexico Board of Dental Examiners will be held in Albuquerque, June 27-29. Applicants must be graduates of a Class A or Class B dental college or university. For application blanks and other information, apply to

J. J. CLARKE, *Secretary,*
Artesia.

SOUTH CAROLINA STATE BOARD OF DENTAL EXAMINERS

The South Carolina State Board of Dental Examiners will meet at Spartanburg, June 7-9.

DAVID AIKEN, *Secretary,*
Winnsboro Bank Bldg.,
Winnsboro.

UTAH BOARD OF EXAMINERS

The next state board examination in dentistry for applicants wishing to practice in Utah will be given at the State Capitol, June 27-30. Credentials must be in the hands of the secretary or department of registration at least ten days prior to June 27.

H. D. BROCKBANK, *Secretary,*
1003 Medical Arts Bldg.,
Salt Lake City.

AMERICAN ACADEMY OF PERIODONTOLOGY

The twenty-first annual meeting of the American Academy of Periodontology will be held at the Minnesota Club, St. Paul, Minn., August 2-4. Members of organized dentistry are invited to attend this program of scientific papers and clinics. Headquarters are the St. Paul and the Lowry hotels.

CLAYTON H. GRACEY, *Secretary,*
966 Fisher Bldg.,
Detroit.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF ORAL DIAGNOSIS

The American Association for the Advancement of Oral Diagnosis will meet in St. Paul, August 6.

WILLIAM B. RYDER, JR.,
2000 Van Ness Ave.,
San Francisco.

AMERICAN FULL DENTURE SOCIETY

The American Full Denture Society will hold its sixth annual meeting in the Spanish Room of the Hotel Lowry, St. Paul, August 4-5.

H. L. HARRIS, *Secretary,*
435 Hamm Bldg.,
St. Paul.

ALUMNI ASSOCIATION OF THE ATLANTA-SOUTHERN DENTAL COLLEGE

The Alumni Association of the Atlanta-Southern Dental College will hold its second annual meeting May 28-30, in accordance with the program which will be mailed to all alumni. All meetings and clinics will be held at the school.

W. EDGAR COLEMAN, *Secretary,*
106 Forrest Ave.,
Atlanta.

MID-SOUTHERN POST GRADUATE DENTAL CLINIC

The fifteenth annual session of the Mid-Southern Post Graduate Dental Clinic will be held at the Hotel Peabody, Memphis, Tenn., October 22-24. All ethical dentists from the states of Alabama, Arkansas, Kentucky, Georgia, Louisiana, Mississippi, Missouri, Oklahoma, Texas, Virginia and Tennessee are especially invited to attend. Each state will be expected to present clinics on the second day. For further information, address

T. R. OGDEN, *Secretary,*
2243 Jefferson Ave.,
Memphis, Tenn.

BINGHAMTON CITY HOSPITAL APPOINTMENT

The appointment of a dental intern at the Binghamton City Hospital will soon be made, to take effect July 1. Applications should be made to Supt. Jerome Peck, Binghamton City Hospital, Binghamton, N. Y.

JOHN H. FARRELL, *Chief,* Dental Staff,
55 Chenango St.,
Binghamton, N. Y.

BRONX HOSPITAL DENTAL APPOINTMENTS

Several vacancies on the dental staff of the Bronx Hospital exist, permitting a number of appointments to be made in the various departments of dentistry. Applications may be made to the Bronx Hospital, Fulton Ave. at 169th St., Bronx, New York.

DAVID WURZEL, *Chief of Clinic,*
3036 Perry Ave.,
Bronx, N. Y.

POSITIONS AVAILABLE ON CONEY ISLAND HOSPITAL STAFF

The dental staff of the Coney Island Hospital of the Department of Hospitals of New York City has several positions available in the outpatient department. The applicants must be New York State registered dentists who are members of the American Dental Association. There is also available the position of dental extern for one year, commencing July 1. Address all communications to

JOHN F. WAHLERS, D.D.S.,
Williamsburg Bank Bldg.,
One Hanson Place,
Brooklyn, N. Y.

AMERICAN DENTAL SOCIETY OF EUROPE

The coming annual meeting of the American Dental Society of Europe is to be held at the Palace Hotel, Scheveningen, The Hague, Holland, during Whitsuntide, May 18-21.

EDWARD J. ORTION, *Secretary.*
14, rue Christophe-Colomb,
Paris, France.

MONTREAL DENTAL CLUB CLINIC

The tenth annual fall clinic of the Montreal Dental Club will be held, October 18-20, at the Windsor Hotel, Montreal.

F. W. SAUNDERS, *Chairman of Publicity,*
Drummond Medical Bldg.,
Montreal, Canada.

F. D. I. HYGIENE COMMISSION AWARD

The Jessen prize, which has been awarded by the Hygiene Commission of the F. D. I. every two years, beginning in 1929, to such organizations or individuals as shall have rendered the most meritorious service in the field of oral hygiene for children during this period, appeals to the societies affiliated with the F. D. I. and to the delegates of the various countries for nominations, suitably documented, of organizations or individuals who, in their opinion, should be considered for the award of the Jessen prize by reason of their work for oral hygiene among children. These nominations on which the Hygiene Commission will base its decision, should be forwarded to Dr. Bruske, Jan Willen Brouwerplein 21, Amsterdam, Holland, before June 15.

For the Hygiene Commission of the F.D.I.
DR. LINNERT (Nurenberg), *President,*
DR. J. BRUSKE (Amsterdam), *Vice President,*
DR. C. H. WITTHAUS (La Haye), *Assistant Secretary.*

AMERICAN DENTAL ASSOCIATION

St. Paul, Minn. Aug. 6-10, 1934.

HOTEL RESERVATION

In securing hotel reservations for the 1934 Session, consult the hotel rate-sheet and fill out the blank application below. Mail immediately to the hotel you wish to patronize. The hotel will then advise you of the reservation which has been made for you.

In case your first choice is not available, kindly indicate a second and a third choice. If none of these are available, the hotel manager will mail your application to the Chairman of Halls & Hotels Committee, who will make as favorable reservation for you as possible.

Please remember that a reservation constitutes a contract with the hotel to provide you with the accommodations you desire. If you find it impossible to carry out your part of the contract, namely, to occupy the room at the time agreed on, please write or wire the hotel, releasing the room reserved for you in order that it may be available to others attending the meeting.

MAIL THIS APPLICATION DIRECT TO THE HOTEL

HOTEL RESERVATION

AMERICAN DENTAL ASSOCIATION, ST. PAUL, MINN., AUGUST 6-10, 1934.

.....Hotel.

St. Paul, Minn.

Please reserve sleeping accommodations as noted below:

.....Room (s) With bath for.....people. Rate desired per day $.....

.....Room (s) Without bath for.....people. Rate desired per day $.....

Second choice hotel..... Third choice hotel.....

ROOMS TO BE OCCUPIED BY:	ADDRESS IN FULL
Applicant.....	.....
.....	.....
.....	.....
.....	.....

Please confirm this reservation to applicant. I further agree to notify the hotel at once in the event I am unable to use this reservation.

IMPORTANT TO HOTEL MANAGER: In the event you cannot accept this reservation, please forward this application at once to Dr. E. J. Simon, Chairman Halls & Hotels Committee, 364 Lowry Medical Arts Bldg., St. Paul, Minn., who will attend to the assignment of this reservation.

HOTEL	With Bath One Person	With Bath Two Persons	Without Bath One Person	Without Bath Two Persons
ANGUS				
165 Western Ave.	$2.50-3.00	$3.50	$1.50	$2.50
	3.50	4.00	2.00	3.00
ASTORIA				
374 Wabasha St.	2.00-2.50	3.00-3.50	1.00	1.50
		4.00-4.50		
COMMODORE				
79 Western Ave.	2.50-3.00	4.00TB*-4.50TB		
	3.50-4.00	5.00TB-5.50TB		
	4.50-5.00	6.00TB		
EUCLID				
405 N. Washington St.	2.00-3.00	3.00-4.00-4.50	1.25	2.00
FREDERIC				
45 East 5th St.	2.00-2.50	3.00-3.50-4.00	1.25-1.50	2.00-2.50
HOTEL JEWELL				
17 East 5th St.	2.00-2.50	3.50-4.00	1.00-1.50	1.50-2.00-2.25
HOTEL ST. FRANCIS				
7th & Wabasha	2.50-3.00	4.00-4.50-5.00TB		
	3.50	5.50TB-6.00TB		
HOTEL ST. PAUL				
363 S. Peter St.	2.50S-3.00	4.00S-5.00		
	3.50	6.00TB-7.00TB		
	4.00 T&S	8.00TB-9.00TB		
	4.50 T&S	12.00 Suites		
	5.00 T&S	15.00 Suites		
LOWRY HOTEL				
339 Wabasha St.	2.50 S	3.50-4.00		
	3.00 S	4.50-5.00		
	3.50-4.00	6.00TB-6.50TB		
	4.50 T&S	7.00TB-7.50TB		
	5.00 T&S	15.00 Suites		
	12.00 Suites			
MARLBOROUGH				
148 Summit Ave.	2.00-2.50	3.00 3.50		
PALMER				
321½ St. Peter St.			1.00	1.50
RYAN HOTEL				
402 Robert St.	2.00-2.50	3.00-4.00TB		
	3.00-4.00	5.00TB-6.00TB		
ST PAUL ATHLETIC CLUB				
340 Cedar St. (Men only)	3.50			

*S, Shower; T&S, tub and shower; TB, twin beds.

PACKAGE LIBRARIES*

Compiled by and Available for Circulation
from the
LIBRARY BUREAU
of the
AMERICAN DENTAL ASSOCIATION
212 East Superior Street, Chicago, Ill.

†Abnormal secretion of saliva.
Absorption of roots and bone.
†Actinomycosis of head and neck.
†Adamantinomas.
†Agranulocytic angina.
Alveolar process—its structure, anatomy and resorption.
Alveolectomy.
Amalgam fillings and physical properties of amalgam.
Anesthesia—discovery and early uses.
†Anesthetics in children's dentistry.
Angle's orthodontic appliances.
Apicoectomy.
Articulation, occlusion and mandibular movements.
Bacteria of the mouth.
Bacteriological studies of root canals.
Best time for orthodontic treatment.
Biographies of dentists.
Blood count in focal infection.
Bogue's articles from Dental Digest.
†Bridges using inlays as abutments.
Broken needles.
Bureau of Standards reports.
Business side of dentistry.
Calcium metabolism.
Cancer of mouth.
†Carbon dioxide administered in conjunction with nitrous oxid-oxygen anesthesia.
†Cast gold crowns.
Cast gold inlays.
Casting gold, including inlays and dentures.
Cavity preparation.
†Cementation of inlays.
Cements—uses and physical properties.
†Child psychology.
Children's dentistry.
Clasps—wire and cast.

*Each package library contains information on one of the subjects listed and is composed of reprints, magazine clippings, etc., on that subject only. The packages are loaned to members of the Association for a period of one week after date of receipt. Unless the material is reserved for another borrower, an extension of time will be granted on request.

The rental fee for borrowing a package library is 50 cents. This fee must accompany the request for a package library. No packages are sold.

†This package contains less than the usual number of articles.

Cleft lip and palate—etiology and surgical treatment.
†Cleft palate—orthodontic treatment and prosthetic appliances.
Community and school dental service.
Comparative dental anatomy.
Conduction anesthesia.
Condyle path movements.
†Congenitally missing teeth.
Contributions dentists have made outside their profession.
†Curetting.
Cysts and tumors of mouth.
Dental assistants.
Dental care of the preschool child.
Dental caries.
Dental clinics.
†Dental disease and practice in the tropics.
Dental economics.
Dental education.
Dental ethics.
Dental health education.
Dental hygienists.
Dental libraries.
Dental metallurgy.
†Dental nomenclature.
Dental service in the World War.
Dental technicians.
Dentifrices.
Dentistry as a career and the status of the dentist.
†Dentistry in foreign lands.
Dentistry of the time of George Washington.
Denture bases—discussion of materials.
Denture casting.
Diabetes and dentistry.
Diathermy in dentistry.
Diet and nutrition in relation to teeth.
Diet in pregnancy.
Diseases of the tongue.
Dry socket.
Education of denture patients.
†Electrogalvanic lesions.
†Emphysema.
Enamel—decalcification and recalcification of.
Endocrine glands in relation to teeth.
†Epithelial débris.
Erosion and abrasion.
†Eruption of teeth—dates of eruption and accompanying symptoms.
†Eruption of teeth—theories regarding.
Esthetics in denture construction.
Ethyl chlorid.
Ethylene anesthesia.
Etiology of caries.
Etiology of malocclusion and preventive orthodontia.
Etiology of pyorrhea and its relation to systemic conditions.
Evolution of human dentition.
Examination of the mouth and oral diagnosis.
Extraction of teeth.
†Facebow technic and recording of occlusion.
Fauchard's (Pierre) life.

Fixed and removable bridgework.
Fixed bridgework.
Focal infection.
†Focal infection and arthritis.
†Focal infection and oral sepsis in relation to gastro-intestinal disturbances.
Focal infection in relation to diseases of the eye.
Foreign bodies (of dental origin) in the lungs and esophagus.
Fractures of the jaws.
Full denture construction.
†Gagging.
Gillett and Irving's articles on indirect inlay technic.
Gold foil.
†Granulomas and granulomatous areas.
Growth and development of teeth and jaws.
Habits as factors in malocclusion.
†Halitosis.
†Hawley's articles.
Hemophilia or excessive hemorrhage following extraction.
Hereditary influences in malocclusion.
†Histologic examinations of fractured roots.
Histologic study of teeth and tissues.
Histology of peridental membrane.
History and progress of dentistry.
History of dental ceramics.
History of dental education in U. S.
History of dentistry.
†History of full denture construction.
Hospital dental service.
†Hypercementosis and excementosis.
†Hypnotism.
Immediate denture service.
Impacted teeth and their relation to various physical disturbances.
Impacted teeth and their removal.
Impacted third molars.
Implantation, replantation, transplantation of teeth.
Impression materials and technic.
†Impression taking for cast gold inlays.
Impression technic.
Indirect inlay technic.
Industrial dental service.
Influence of deciduous teeth and first permanent molars on occlusion.
Influence of dental improvements on appearance and mental conditions.
Influence of diet on saliva.
Interpretation of roentgenograms.
Investment compounds and technic.
Ionic medication.
†Jackson's (V. H.) articles on orthodontic appliances.
†Labial frenum.
Lectures to nurses.
Lesions of the mouth.
†Leukemia.
†Leukoplakia.
Local anesthesia.
Local anesthesia—contraindications and untoward results.
Lower denture construction.
†Ludwig's angina.
Malpractice in dentistry.

Materia medica and pharmacology.
†Matrix.
Maxillary sinus and antrum—diseases and treatment.
Methods of sectioning and staining teeth.
Monson's theory.
Mottled enamel.
Mouth hygiene.
Muscle exercises and training in orthodontia.
Nitrous oxid-oxygen analgesia.
Nitrous oxid-oxygen anesthesia.
Occlusion in partial dentures.
†Occlusion in relation to operative dentistry.
†Opening the bite.
Oral diagnosis with reference to roentgen ray.
†Oral manifestations of metallic and drug poisoning.
Oral manifestations of systemic conditions.
Organized dentistry.
Orthodontia and its relation to dentistry and medicine.
†Orthodontia for general practitioner.
†Orthodontic anchor bands.
Orthodontic appliances.
Orthodontic diagnosis and measurements.
†Orthodontic treatment of impacted cuspids.
Osteomyelitis of the jaws.
"Panel" or insurance dentistry.
Partial dentures.
†Permeability of tooth structures.
Physical therapy in dentistry.
†Pinledge and pinlay attachments.
Place of extraction in orthodontic treatment.
Plastic surgery.
Pollia's articles on radiology.
Porcelain in dentistry.
Porcelain inlays.
Porcelain jacket crowns.
Postoperative complications and care.
†Postoperative psychosis.
Pregnancy and dental disease.
Preoperative examination of patients.
Preparation of cavities with hypersensitive dentin.
Preventive dentistry.
Procain (novocain) dermatitis.
†Program building for state and district societies.
Prophylactic odontotomy.
†Pulp amputation.
Pulp conservation including pulp capping and cavity lining.
†Pulp pathology.
†Pulp stones.
Pyorrhea.
†Referred pain.
Relation between dental conditions and the mental health of insane.
Relation of the dentist to the physician.
Removable bridgework.
†Removable bridgework—discussing various types of attachments.
Research Commission reports.
Restoration of oral function including opening the bite.
Retainers used in orthodontia.

Retention of deciduous teeth and delayed eruption of permanent teeth.
†Retrusion of the mandible causing impaired hearing.
†Roofless dentures.
Root canal treatment.
†Salivary calculus.
†Salivary glands.
†Shock, syncope and collapse.
Should dentistry be advertised?
Silicate cements (see cements—uses and physical properties).
†Silver nitrate.
†Smith's articles on oral prophylaxis.
†Space retention—its importance and methods of accomplishing.
†Speech defects and training.
†Staining porcelain teeth.
†Stainless steel and chrome alloys.
†Status lymphaticus.
Sterilization of dental instruments.
Stomatologic program (A.S.S.).
Stomatology—general discussion of.
Stories and rhymes for children.
Studies of enamel, including permeability, staining, organic content, etc.
Studies of saliva.
Suggestions for talks to mothers.
Suggestions for talks to students.
†Supernumerary teeth.
Surgical treatment of pyorrhea.
Syphilis and its relation to dentistry.
Three-quarter crowns.
Tooth arrangement for full dentures.
Toothbrushes and toothbrushing technic.
Toothbrushes, tooth pastes and mouth washes.
†Torus palatinus.
Transplantation of teeth (see implantation of teeth).
Traumatic occlusion.
Trigeminal neuralgia.
Trismus and ankylosis.
Tuberculosis and dentistry.
Ultraviolet ray in the treatment of pyorrhea.
Ultraviolet ray therapy in dentistry.
Undergraduate and graduate orthodontic education.
Use of elevators in extraction.
Value of dental service in schools.
Value of roentgen-ray examinations in orthodontia.
Various studies of or pertaining to saliva.
Vincent's infection.
Vulcanite and vulcanite stomatitis.
Waxes and wax expansion method.
†Willett's articles.

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